The Welding Engineer

Reg. U. S. Pat. Office

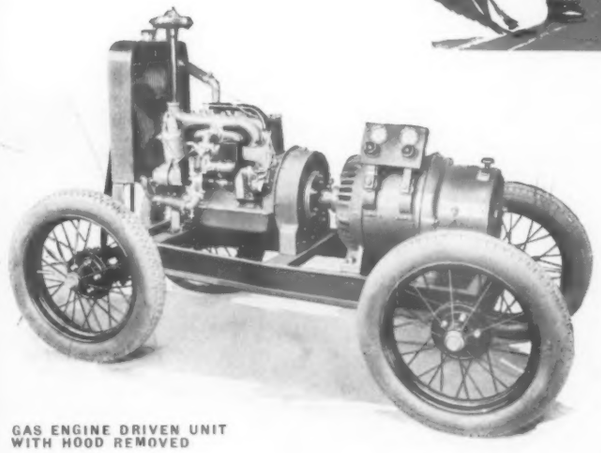
Founded by L. B. Mackenzie, 1916

DECEMBER, 1928 VOL. 13, NO. 12

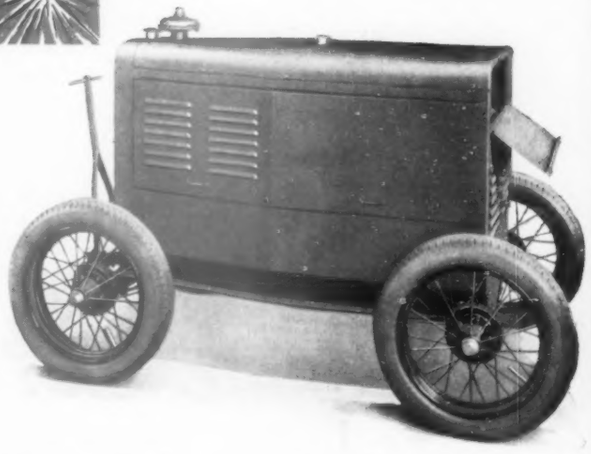
$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

FUZON
Arc Welders
Motor Generator Units
Gas Engine Driven Units

Weldite
Welding Rods
for Gas and Electric Welding



GAS ENGINE DRIVEN UNIT WITH HOOD REMOVED



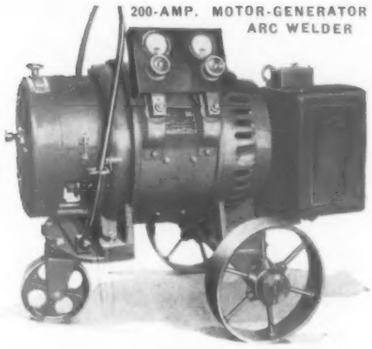
GAS ENGINE DRIVEN UNIT WITH HOOD

FUZON *Arc Welders*

New and simple generator design gives low welding costs and insures long life.

Gas Engine Unit

Travels wherever a car can be driven.



200-AMP. MOTOR-GENERATOR ARC WELDER

Weldite *Welding Rods*

A type for every kind of welding job to give lowest possible welding costs and best quality of deposited metal.

Write for descriptive Bulletins on Weldite Welding Rods for Oxy-acetylene and Electric Welding, also Fuzon Welding Machines and Accessories.

CHICAGO STEEL & WIRE COMPANY

FUSION WELDING DIVISION

FUZON *Arc Welders* — *Weldite* *Welding Rods*

103rd Street and Torrence Avenue • Chicago

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

NOVIWELD LENSES
for welder's helmets and goggles

CALOBAR LENSES
for forge and furnace workers' goggles

1929 specifications for complete protection from injurious light . .

NOVIWELD glass has been further developed. No other welding glass gives the sure protection and the comfort of the new Noviweld (NW). It is a complete safeguard against the sensation of "hot sand in the eyes", red eyelids and other annoyances common to welders. It protects welders' eyes against 99.9% of injurious rays. We want you to see the spectrum transmission chart that shows graphically the absorption value of New Noviweld.

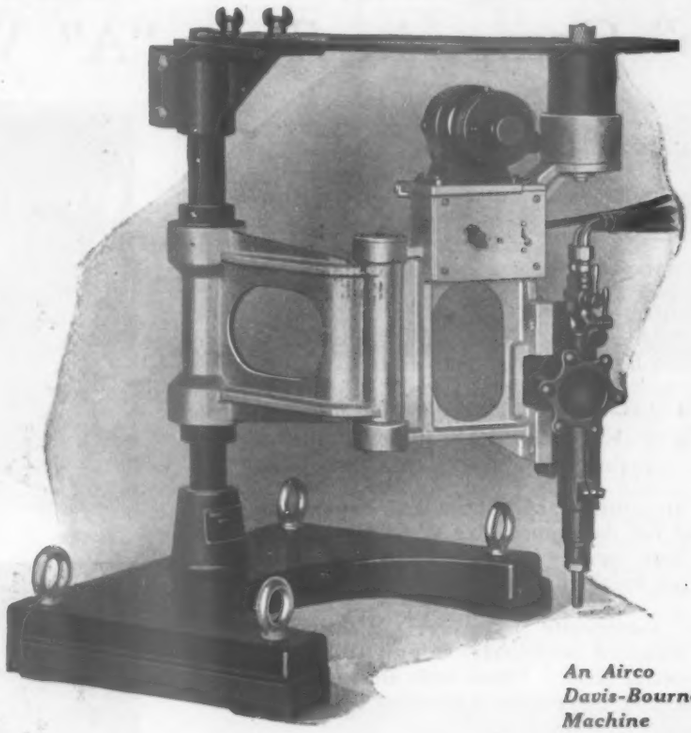
CALOBAR glass protects the eyes from injurious rays encountered by men working at forges and furnaces, where high temperature produces excessive quantities of heat and light. The high visibility of Calobar glass shows all colors in their true value. It has a soft, restful shade, and gives you a high percentage of helpful light. Men working at forges and furnaces need exactly this protection together with high visibility.

These lenses should be your standard equipment for 1929

American Optical *Company*

Safety Division

NEW YORK ST. LOUIS SAN FRANCISCO CHICAGO KANSAS CITY ATLANTA



An Airco Davis-Bournonville Machine

An Oxyacetylene Shape Cutting Machine For Production Work---The No. 4 Camograph

This machine combines the principles of the No. 2 Camograph with improved design, increased cutting area, superior motor control and torch adjustment, and new cam features. Height 26-in., Base 22 x 15-in., Weight 150 lbs. Normal cutting area 14-in. diameter circle. By reversing machine base the torch will cover the upper segment of a 36-in. diameter circle having a 33-in. base line.

A cam conforming to the shape to be cut (attached at top of machine) is guide for a magnetized roller, actuated by a 75-Watt 110-Volt variable speed universal motor, which directs the oxyacetylene cutting torch. Cams are readily interchangeable. Direct current required, or motor generator set with A. C.

Inquiries for specific information invited by all Airco District Offices.

AIR REDUCTION SALES COMPANY

Manufacturers and distributors of Airco Oxygen, Airco Acetylene, Airco National Carbide Airco-Davis-Bournonville Welding and Cutting Apparatus and Welding Supplies

Baltimore
Bettendorf, Ia.
Birmingham
Boston
Buffalo
Charlotte, N. C.
Chicago
Cleveland
Dayton
Detroit
Emeryville, Calif.
Jersey City

AIRCO
DAVIS BOURNONVILLE

Los Angeles
Milwaukee
Minneapolis
Oklahoma City
Philadelphia
Pittsburgh
Richmond
Seattle
St. Louis
Wheeling

75 Plants *Home Office*—**342 Madison Avenue, New York City** **22 District Offices**

For Automatic Arc Welding "Raco" Composite Type "A" Wire

A WIRE specially developed for use with automatic Arc Welding machines.

The outstanding feature of "Raco" Composite Type "A" Wire is a series of lengthwise grooves containing a most efficient arc stabilizing material which cannot be chipped out by the feed rollers.

A perfect contact is insured due to the absence of flux on outside of wire and also due to the fact that the wire is solid rather than made up of several units.

We are able to guarantee highest possible speed, absolute uniformity and arc stability with the finest possible quality of welds.

The prices are considerably lower than is usual on wires ordinarily used for Automatic Arc Welding on account of the relatively high speed with which our continuous process produces our finished product.

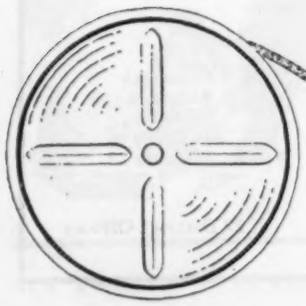
All "Raco" Composite Type "A" Welding Wire is furnished in standard compactly wound coils which exactly fit our special reels. These reels are interchangeable with reels generally used with Automatic Welding Heads and will fit present mountings.

Shipping the wire in coils saves incoming and outgoing freight on a considerable number of reels also the deposit on reels while in customer's hands.

One special reel at nominal cost is needed for each automatic welding head in operation.

The widespread success that has rewarded the efficiency of this wire is attested by the fact that today practically every large installation of automatic arc welding machines in the country is using "Raco" Composite Type "A" Wire.

If you will advise us what size wire you are using at the present time we will be happy to forward you samples for test purposes—all charges prepaid—and quote you prices.



REID-AVERY CO., Inc.

21st and Washington Avenue Philadelphia, Penna.

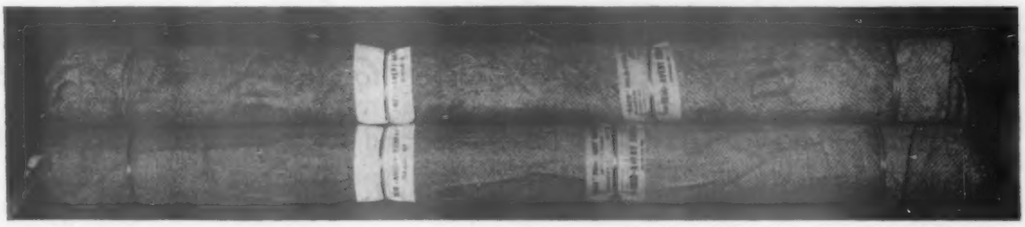
Works: Baltimore, Md.

Announcing the New

"Raco" Composite Type "B" Electrode

for Manual Welding

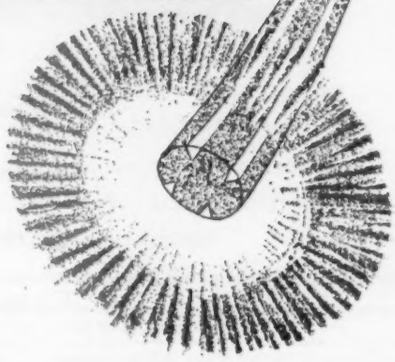
THIS Electrode is of standard .13 to .18% carbon analyses and each rod has lengthwise grooves rolled into its entire length. These grooves are filled with a remarkable arc stabilizing agent. Due to its construction we are able to guarantee absolute uniformity with no rejections from any cause whatsoever. *This electrode has splendid penetration and high welding speed in addition to absolute uniformity.* We do not believe that uniformly satisfactory results can be obtained over a period of time with a bare electrode, and Raco Composite Type "B" Wire has been perfected with a view of getting away from inequalities of bare wire. The arc stability of this new wire is so perfect that it may be used with equal success with either D.C. or A.C. current where Flux Coated Electrodes have been considered necessary. The cost of this electrode is no more than a good grade of bare wire and means absolute satisfaction. It is the most reliable electrode on the market for straight production use.



We also manufacture Raco "Red Label" (Copper Coated) rods for gas welding in both pure iron and mild steel grades. These rods are unqualifiedly guaranteed to be the finest quality on the market today.

In addition to the rods mentioned above are "Raco" .95 — 1.10 high carbon rods and "Raco" 3½ percent nickel steel rods.

Samples of any of these rods will be cheerfully furnished on request, charges prepaid. Please advise sizes desired.

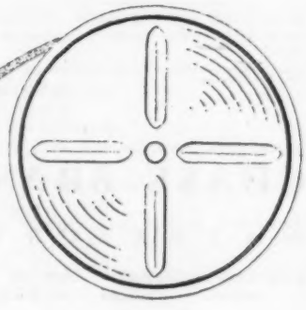


DEALERS ATTENTION: We have at present a most attractive proposition in some very desirable territory. Write us at once.

REID-AVERY CO., Inc.

21st and Washington Avenue Philadelphia, Penna.

Works: Baltimore, Md.



HERE'S A BRONZE WELDING ROD THAT MEASURES UP . . .

You'll find in Chase Chāmet Bronze Welding Rod all the qualities you would naturally look for in a top-grade bronze rod. It's made from our own particular mixture of bronze, and specially named "Chāmet" to distinguish it from other bronzes.

For look where you will, you won't find a better bronze welding rod than Chāmet. Big job or little job, intricate job or simple job, Chāmet has the happy faculty of measuring up.

Get the habit of looking for the distinctive Chase-mark—shown below—on box, label and tag; and stamped* into the end of every length of Chase Welding Rod.

Furthermore . . . When you're in a hurry you can depend on Chase service. Thirteen Chase warehouses throughout the country mean that *there's a Chase warehouse near you.* Order from any one of them or through them from the factories and mills of the Chase Companies, Inc., Waterbury, Connecticut.

* *This Mark Identifies all Chase Chāmet Bronze Welding Rod.*

CHASE WELDING RODS

BRASS
CHĀMET BRONZE
MANGANESE BRONZE

CHASE BRASS AND COPPER CO.
INCORPORATED
WATERBURY · CONNECTICUT

New York · Boston · Newark · Philadelphia · Baltimore · Cincinnati · Cleveland
Detroit · Chicago · St. Louis · New Orleans · Los Angeles · San Francisco

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 13 | December, 1928 | Number 12

CONTENTS

Los Angeles Welcomes Western Welders 39
Water Line Welding—An Evolution 41
The "Whys" of Production Welding 43
By J. O. Bishop.
Acetylene in the St. Francis Dam Disaster 50
By J. B. Ross
Arc Welding Brass and Bronze 53
By R. H. Davis
Making the Oil Men Like It 55
By C. L. McCorkindale
Arc Welding Boiler Tubes 57
By G. H. Clark
Steel Storage Tank Construction 61
By E. C. Moore
Editorial 37
Student Welds Airplane Model 40
Street Railways Find Welding Increasingly Useful 42
650 Tons of Metal Removed with Torch 42
Tells Gear Makers About Welding 47
Welding Fittings for Corrugated Pipe 49
Welded Steel Concrete Road Forms 52
Purdue Holds Fourth Welding Conference 54
Remarks on Welding as a Business 56
High Pressure Line Welded and Annealed in Trench 56
Tool Room and General Welding 58
An Emergency Cutting and Welding Job 60
Welded Parking Signs 60
News of the Welding Trade 66

To Encourage Good Workmanship

MANY a workman has been discouraged from mastering the art of welding through lack of interest on the part of the management. Furnished with inferior equipment, and with materials not selected for welding quality, and parts poorly designed for welding, he is handicapped at the start. On top of that, the policy of buying the cheapest materials means the sacrifice of all kinds of engineering service which the makers of quality materials consider an essential part of their product. Under such conditions the workman has to fight all kinds of trouble single-handed. Some of them come out all right by force of ability and determination. But in other cases the experiment is finally written up as a costly failure and the plant loses the use of a valuable process. No doubt in many such cases the workmen know that they are not being given the best chance to succeed. It is logical to expect that men will take the best care of good equipment and will put forth their best efforts when they know that every effort is made to arrange all the conditions in their favor. There is something very human about the response to the feeling of "getting a good break."

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Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.

ACETYLENE CYLINDERS
Keith Dunham Company
Pressed Steel Tank Co.

AIR LIQUEFACTION OXYGEN PRODUCING PLANTS
Keith Dunham Company
Heylandt Sales Co.

ALUMINO-THERMIC WELDING
Metal & Thermit Corporation

ALUMINUM SOLDER
Crown Aluminum Solder Co.
Miller Aluminum Solder Co.
Weldene Corporation

ANNEALING FURNACES
General Electric Co.
Westinghouse Elec. & Mfg. Co.

APRONS (Asbestos)
Ideal Face Shield Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

BOOKS
The Welding Engineer Pub. Co.
Electric Arc Cutting & Welding Co.

BRAZING OUTFITS
Air Reduction Sales Co.
American Oxygen Service Co.
Bastian-Blessing Co.
Buckeye Oxygen Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Williams & Co.

BRONZE FILLER RODS
American Brass Co.
Central Steel & Wire Co.
Chase Brass and Copper Co., Inc.
Krembs & Co.
Mueller Brass Co.
Steel Sales Corp.

BUFFERS
Biax Flexible Shaft Co.
R. G. Haskins Co.
N. A. Strand & Co.

BUTT WELDERS
See "Electric Resistance Welders"

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
Quasi-Arc Weldtrode Co.
Una Welding and Bonding Co.
U. S. L. Battery Corp.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CARBIDE
Air Reduction Sales Co.
National Carbide Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBON (Blocks, Paste, Electrodes, etc.)
Air Reduction Sales Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

CARBON BURNING EQUIPMENT
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.

CAST IRON SOLDER
Crown Aluminum Solder Co.
Weldene Corporation

CAUSTIC POTASH
Innis, Speiden & Company

CONSULTING ENGINEER
R. F. Hollinger
R. B. Kinkead
R. C. Pierce

CONTRACT WELDERS
S. O. S. Welding Corp.

CUTTING ELECTRODES (Electric Arc)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company
Pressed Steel Tank Co.

CYLINDERS (Oxygen, Hydrogen)
Chas. L. Gulick.
Wm. Wharton, Jr. Co.
Harrisburg Pipe & Pipe Bending Co.

DRILLS, PORTABLE ELECTRIC
Biax Flexible Shaft Co.
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

ELECTRIC ARC WELDING OUTFITS
Allan Mfg. & Welding Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Electric Welding Machine Co.
Fusion Welding Corporation
General Electric Co.
Goodman Electric Machinery Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Lincoln Electric Co.
E. A. Lundy Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Co.
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRIC RESISTANCE WELDERS
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machines Co.
Goodman Electric Machinery Co.
R. D. Thomas Co.

ELECTRODES (Carbon Arc Welding)
See "Cutting Electrodes"

ELECTRODES (Metallic Arc Welding)
American Steel Engineering Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corporation
Koro Corporation
Lincoln Electric Co.
Page Steel & Wire Co.
Quasi-Arc Incorporated
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Company
Una Welding and Bonding Co.
Welding Service Co.
Wickwire Spencer Steel Corp.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE HOLDERS
Allan Mfg. & Welding Co.
Burke Electric Co.
Chicago Steel & Wire Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Koro Corporation.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Stoody Co.
Waters Arc Welding Corporation
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

ELECTRODE TIPS (Resistance Welding)
Elkon, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

FACE SHIELDS (Arc Welding)
Allan Mfg. Co. & Welding Co.
American Optical Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
Gibb Welding Machines Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Stoody Company
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Wilson Goggles, Inc.

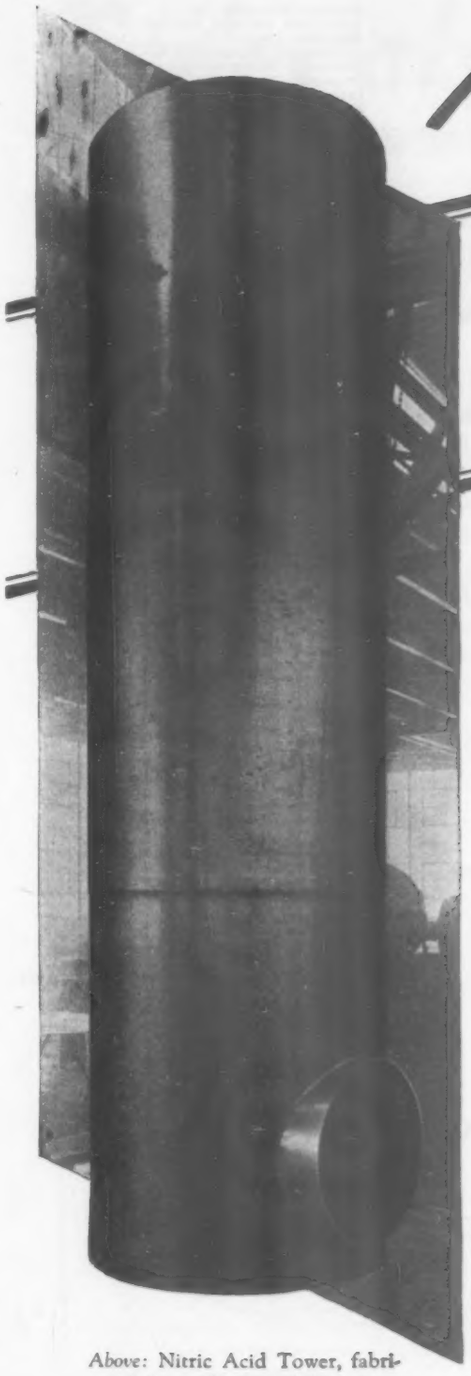
FILLER RODS
Air Reduction Sales Co.
American Brass Co.
American Steel Engineering Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
C. H. Hollup Corp.
Imperial Brass Mfg. Co.
Krembs & Co.
Mueller Brass Co.
Koro Corporation
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
St. Paul Welding & Mfg. Co.
Standard Steel & Wire Co.
Steel Sales Corp.
Stoody Co.
Stulz-Sickles Co.
Torchweld Equipment Co.
Welding Service Co.
Wickwire Spencer Steel Corp.
Weldit Acetylene Co.
Williams & Co.

FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Anti-Borax Compound Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Gold Seal Mfg. Co.
Krembs & Co.
Modern Engineering Co.
Momac Sales Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Simplex Flux and Solder Co.
Torchweld Equipment Co.
Weldene Corporation
Weldit Acetylene Co.

GAS SAVING DEVICES
Harris-Calorific Co.
Weldit Acetylene Co.



NOW they're ELECTRIC WELDED!

NITRIC ACID TOWERS
made of Chrome Alloys
Are Being ELECTRIC WELDED
with *Wilson Machines*

HERE is one of the Nitric Acid Towers, made of non-corrosive chrome alloy, which Industrial Welded Products Co. Inc., Newark, N. J., is fabricating entirely by *electric* welding—and *exclusively* with Wilson Welding Machines!

The welds in these tanks not only exhibit extraordinary strength and ductility, but also show *resistance to corrosion equal to the chrome alloy plates which they join!*

In addition, Industrial Welded Products Co. is welding plates of chrome iron, chrome nickel alloys, special alloys and stainless steel in the construction of fans for heavy nitric fumes; large pressure acid tanks; pipes and fittings for nitric acid; and other similar equipment.

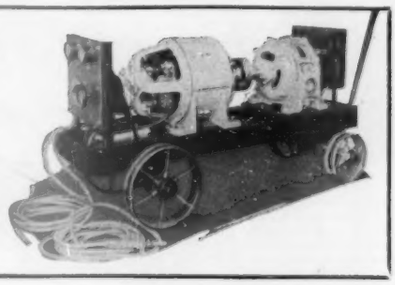
These welds are uniformly sound and homogeneous. They can be ground flush and given a high polish. Their tensile strength equals at least 90% of the tensile strength of the plate itself, and they actually *exceed* the elastic limit of the plate. In ordinary use, they have resisted nitric acid of all concentrations, up to 185° F., and under pressure.

This work conclusively demonstrates the close current control that can be secured with the Wilson Welding Machine—a current control so close, so stable, and of such value, that special alloys can be welded without losing the effect of their essential elements in the weld.

Send for Bulletins describing all the Wilson Model S Welding Machines.

Above: Nitric Acid Tower, fabricated from Chrome Alloy plates by means of electric welding, These all-welded tanks are being produced by Industrial Welded Products Co. Inc., Newark, N. J., who use Wilson Machines exclusively.

At the right is shown a Wilson Model S Welding Machine, one-operator electric-motor-driven, Type 200 Amperes, welding range 10-300 Amperes. Other Wilson Model S Machines include one-arc gasoline-engine-driven, belt-driven or motor-driven units, and a two-arc motor-driven unit. Capacities: 10-300, 10-600, 15-1000 Amp.



WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

WILSON

WELDING MACHINES AND WELDING WIRE

GLOVES (Asbestos)
Ideal Face Shield Co.
GAUGES
Moto Meter Co.
National Gauge & Equipment Co.
GENERATORS (Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
M. Keith Dunham
Imperial Brass Mfg. Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
GLOVES
Morrison-Ricker Mfg. Co.
GOGGLES
American Optical Co.
Chicago Eye Shield Co.
Ideal Face Shield Co.
Willson Goggles, Inc.
GRAPHITE (Rods, Blocks, Paste, Etc.)
Joseph Dixon Crucible Co.
GRINDERS (Portable Electric)
Biax Flexible Shaft Co.
R. G. Haskins Co.
Stoody Company.
N. A. Strand & Co.
HELMETS (Arc Welding)
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See also under "Needle Valves"
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K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
NICHROME WELDING WIRE
Driver-Harris Co.
NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.
OXYGEN
Air Reduction Sales Co.
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Gas Products Association
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Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
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SEAM WELDERS
See "Electric Resistance Welders"
SILVER SOLDER
Handy & Harman
SWEDISH IRON WELDING WIRE
Bissett Steel Co.
SPOT WELDERS
See "Electric Resistance Welders"
TANK CONNECTIONS
Air Reduction Sales Co.
Bastian-Blessing Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
THERMIT WELDING
Metal & Thermit Corp.
TORCHES (Welding and Cutting)
Air Reduction Sales Co.
American Oxygen Service Co.
Buckeye Oxygen Co.
Craftsweld Equipment Co.
Bastian-Blessing Co.
Fusion Welding Corporation
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Stoody Company
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
Williams & Co.
TRUCKS (Cylinder)
Air Reduction Sales Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Torchweld Equipment Co.
VALVES
Air Reduction Sales Co.
International Oxygen Co.
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Air Reduction Sales Co.
Joseph Dixon Crucible Co.
Modern Engineering Co.
National Carbon Co.
WELDING ROD HOLDERS
C. Sorensen
WELDING RODS AND WIRE
See "Electrodes" and "Filler Rods"

ALPHABETICAL INDEX TO ADVERTISERS

A

Air Reduction Sales Co. 8
Allan Mfg. and Welding Co. 77
American Brass Co., The 67
American Optical Company ..... Inside Front Cover
American Steel Engineering Co. ....
American Steel & Wire Co. 73
American Welding Society 72
Anti-Borax Compound Co. 82
Atlas Foundry Co. 77

B

Bastian-Blessing Company 38
Biax Flexible Shaft Co. 78
Bisset Steel Co. 81
Burke Electric Co. 81

C

Central Steel & Wire Co. 22
Chase Brass and Copper Co., Inc. 6
Chicago Eye Shield Co. 80
Chicago Steel & Wire Co. ..... Front Cover
Commercial Acetylene Supply Co. 73
Craftsweld Equipment Co. ....
Crown Aluminum Solder Co. 79

D

Dixon Crucible Co., Joseph 80
Driver-Harris Co. 69
Dunham, Keith, Co. ....

E

Elec. Arc Cutting & Welding Co. ..... Back Cover
Elkon, Inc. 80
Electric Welding Machine Co. 29

F

Federal Machine & Welder Co. 11
Fibre Metal Products Co. 77
Gas Products Assn. 32

G

General Electric Co. 20, 21
Gibb Welding Machine Co. 78
Goodman Electric Mach. Co. ....
Gulick, Charles L. ....

H

Handy & Harmon 75
Harrisburg Pipe & Pipe Bending Co. ....
Harris Calorific Co. ....
Haskins Co., R. G. 79
Hobart Brothers 24
Hollup, C. H. 34

I

Ideal Face Shield Co. 81
Innis, Speiden & Company 76
Imperial Brass Mfg. Co. 70
International Oxygen Co. 80

K

K-G Welding Co. 69
Kinkead, R. E. 82
Koro Corporation 19

L

Lincoln Electric Co. 35
Linde Air Products Co. 16

M

Matchless Utilities Co. ....
Metal and Thermit Corp. ....
Alexander Milburn Co. 12, 13
Modern Engineering 33
Moto Meter Co. 36
Mueller Brass Co. 18

N

National Carbide Co. 74
National Carbon Co. ....
National Gauge and Equipment Co. 36
National Welding Engineers 82
Northwestern Mfg. Co. 72
Norgren, C. A., Co. 82

O

Owen Electric Mfg. Co. 77
Oxweld Acetylene Co. ....

P

Page Steel & Wire Co. 71
Pressed Steel Tank Co. 72
Prest-O-Lite Co., Inc., The 17

Q

Quasi Arc, Incorporated 27

R

Reid-Avery Co., Inc. 4, 5
Roebling, John A., Sons Co. 31

S

Safety Gas Lighter Co. ....
Seneca Wire Mfg. Co. 79
Shawinigan Products Corp. 79
Shrader Electric Co. 81
Shootalite Corporation 76
Simplex Flux & Solder Co. ....
Sorenson, C. 82
Standard Steel & Wire Co. 68
Steel Sales Corp. 71
Strand, N. A. & Co. 82
Stoody Co. 14, 15
St. Paul Welding & Mfg. Co. 82

T

Torchweld Equipment Co. 74

U

Underwater Cutting Corporation 78
Union Carbide Sales Co. 23

V

Victor Oxy-Acetylene Equipment Co. ....

W

Weldit Acetylene Co. 76
Westinghouse Electric & Mfg. Co. 25
Wickwire Spencer Steel Corp. 75
William Wharton, Jr., & Co., Inc. ....
Williams & Co., Inc. 78
Willson Goggles, Inc. ..... Inside Back Cover
Wilson Welder & Metals Co. 9

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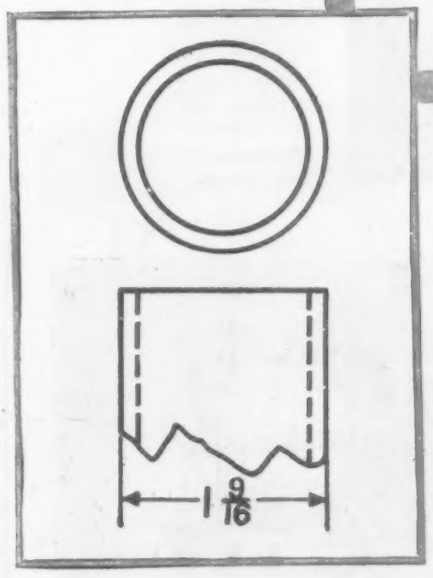

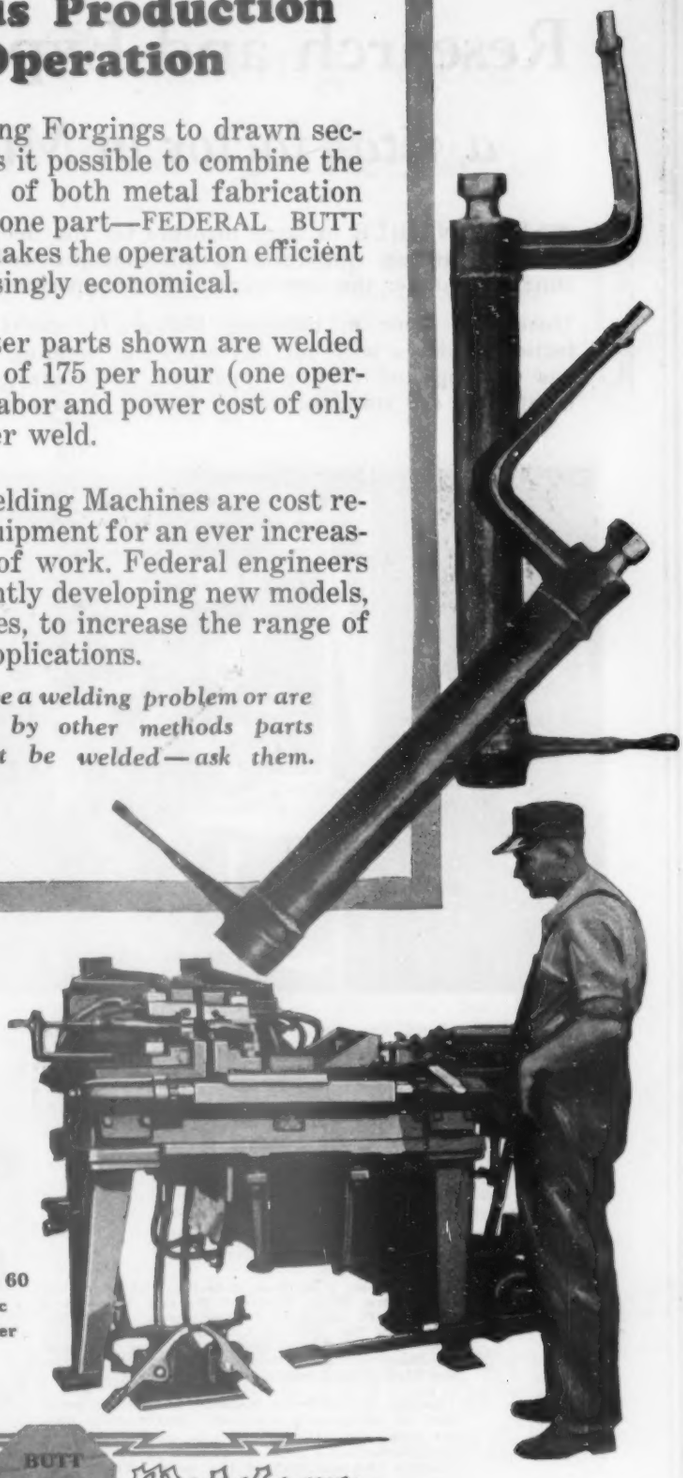

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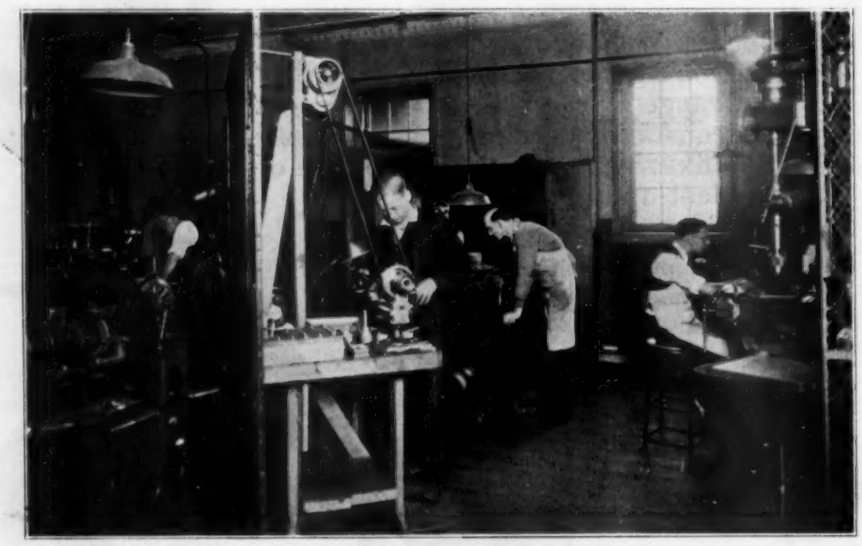
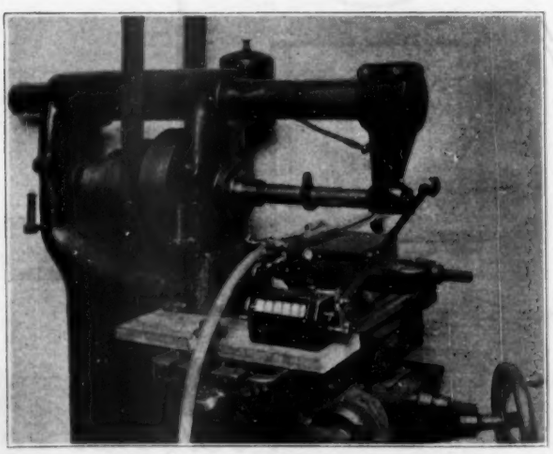
Unceasing labor in bringing Milburn products to the highest attainable degree of perfection explains why our oxy-acetylene welding and cutting apparatus, oxy-illuminating gas welding and cutting apparatus, acetylene generators, paint and lacquer spray equipment, etc., are standardized by leading companies throughout the world.



A corner of one of the Milburn experimental departments



This shows a method of testing the operation of Milburn High Pressure Oxygen Valve and Seat on its standard cutting torch. It is the custom of the Milburn Company to make periodic tests of this character in order to bring the longevity and efficiency of its equipment to the highest attainable standards.

In the above-shown instance an oxygen pressure of 250 pounds was used continuously and the valve operated at the rate of 120 impacts per minute for a total of 117,000 operations, or closings and openings of the valve. The result showed that the seat and valve developed no leakage or impairment of any kind.

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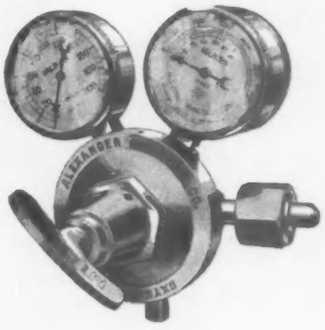
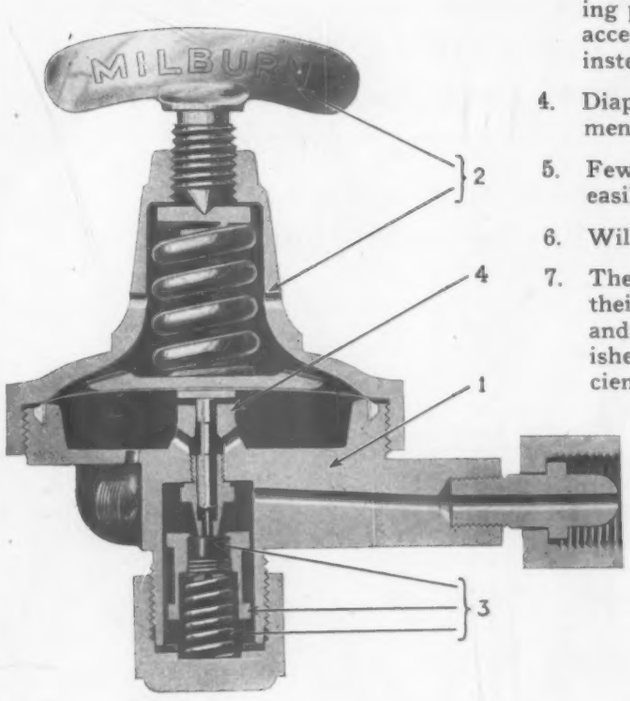
with this "Constant Pressure" Regulator





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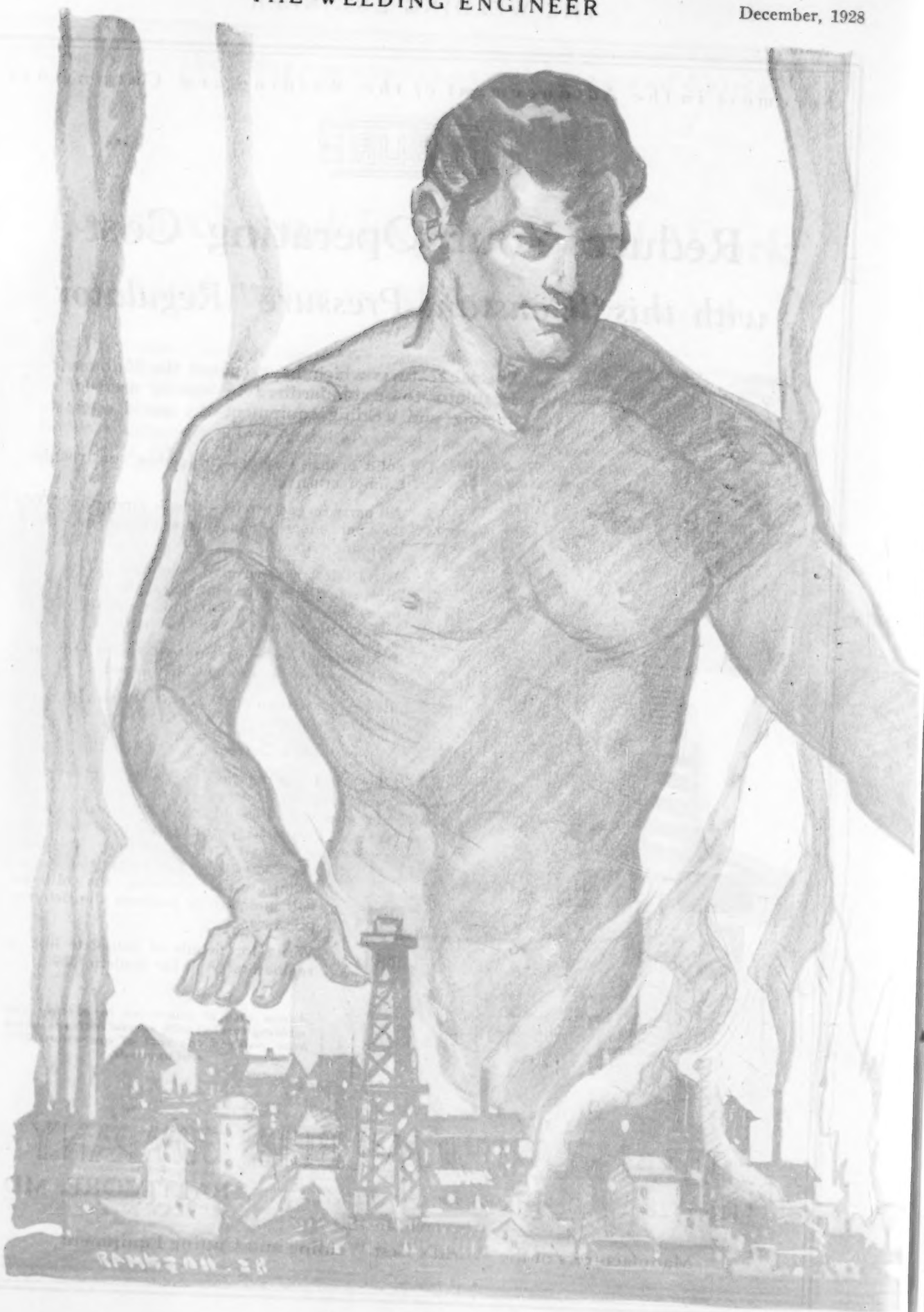

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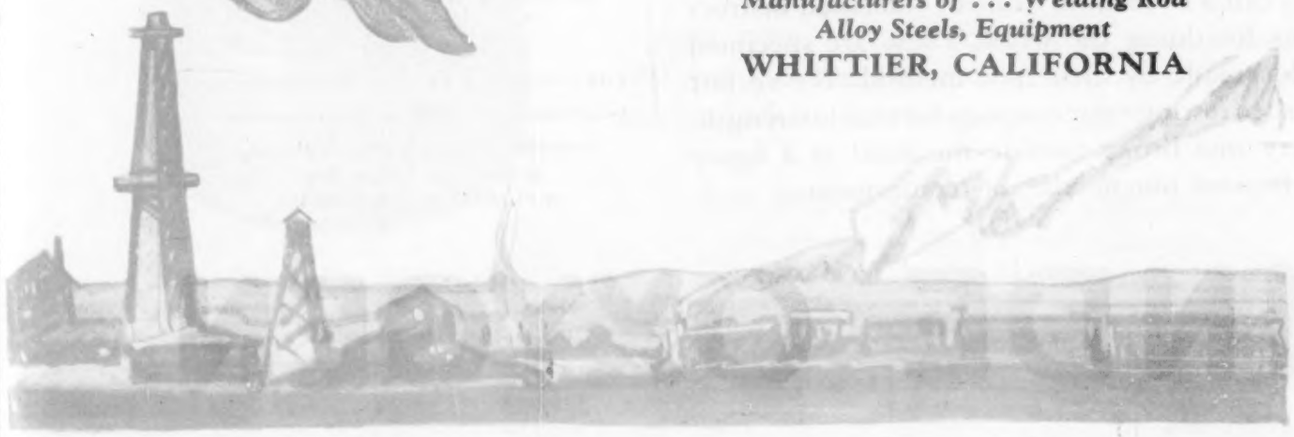

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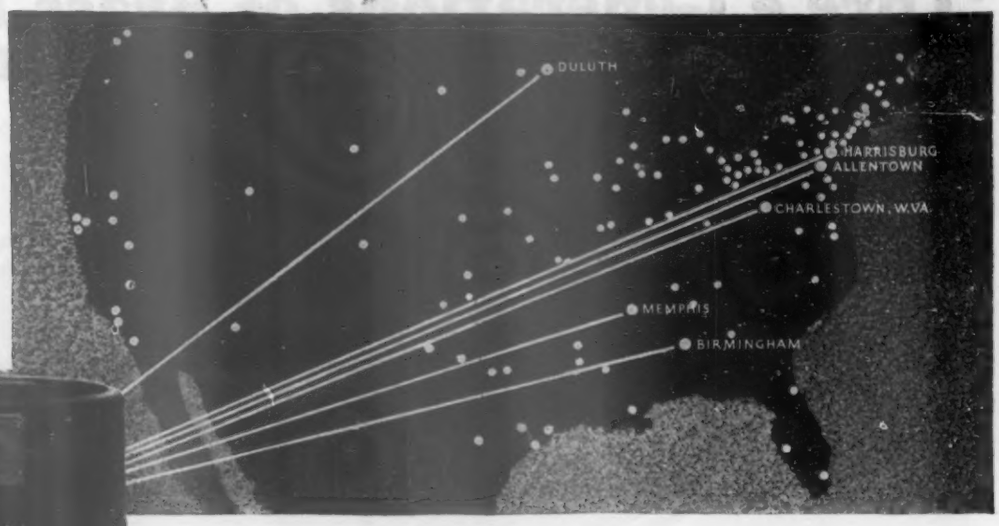

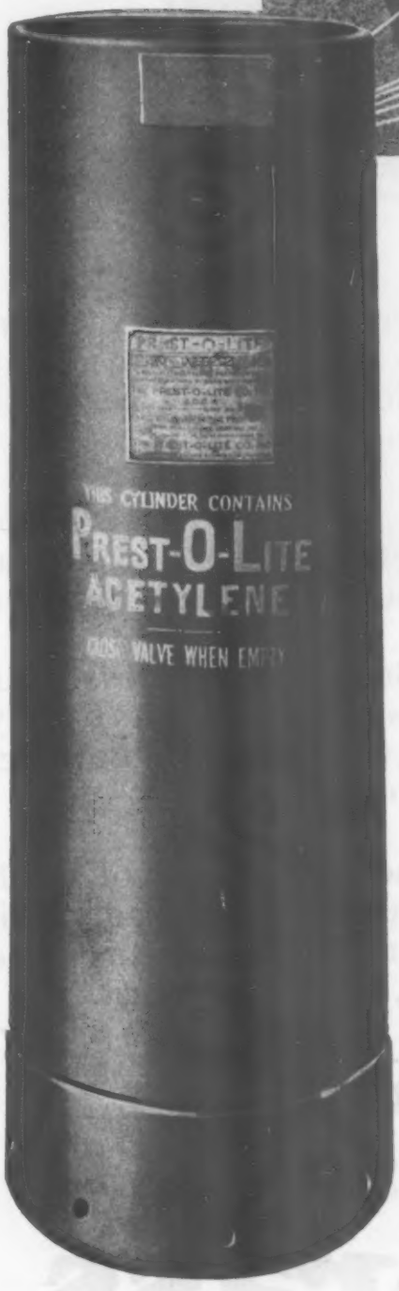

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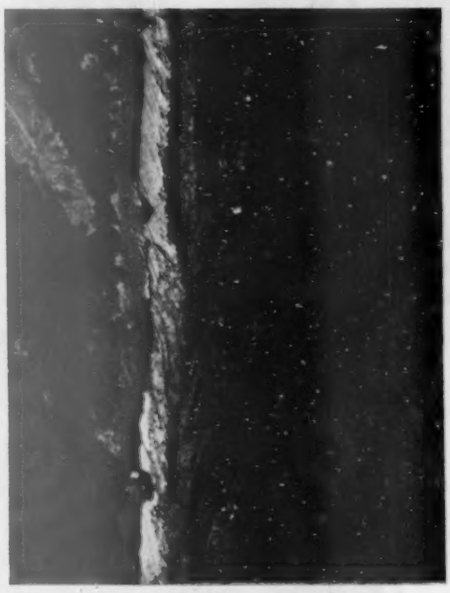
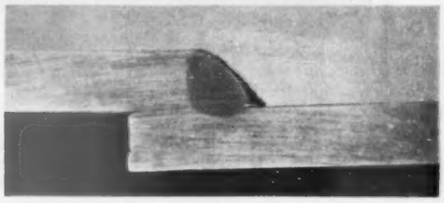


Close-up of the weld being made at left. Using a 3/16" KORO grade 1 Automatic Arc Welding Wire on a lap seam in 5/16" boiler plate a speed of 72 feet per hour has been attained. Surface has been slightly ground to show soundness of deposit.



Etched section of weld shown above. Note freedom from porosity, good penetration and general evidence of soundness in weld deposit.

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(Patent applied for)
AUTOMATIC ARC
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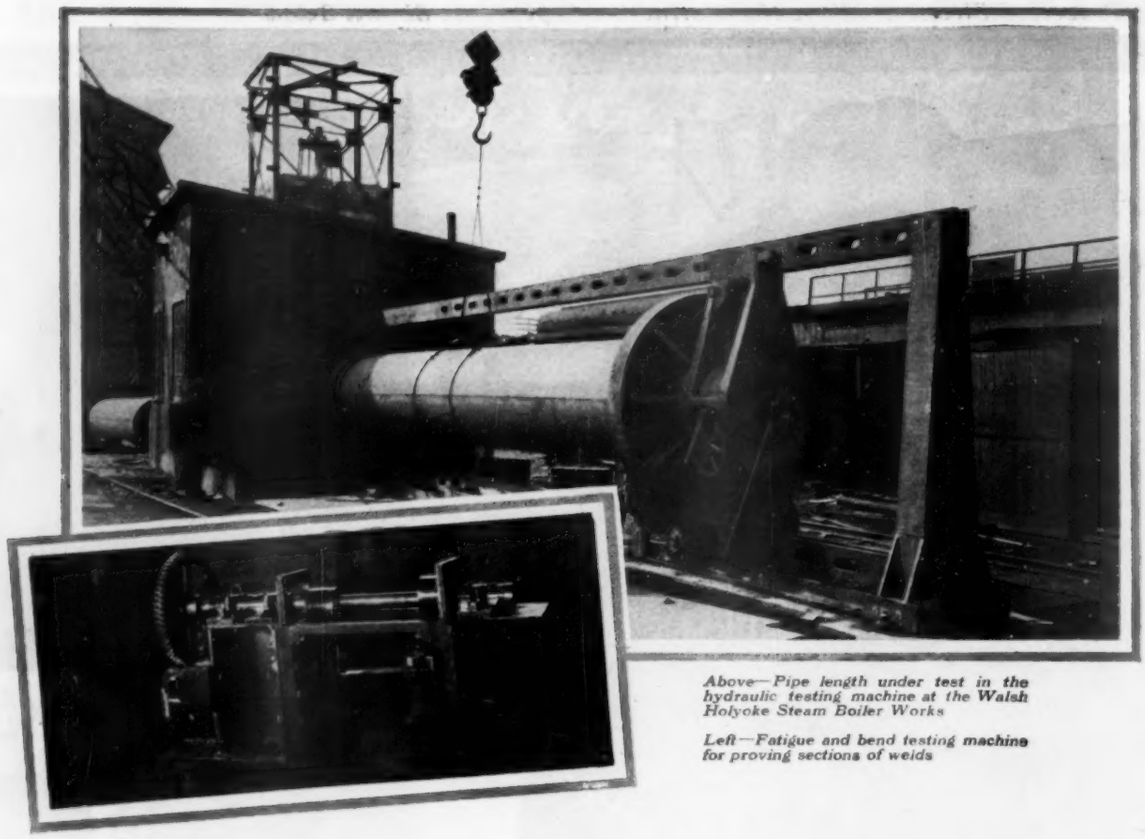

Above—Pipe length under test in the hydraulic testing machine at the Walsh Holyoke Steam Boiler Works

Left—Fatigue and bend testing machine for proving sections of welds

The Test of the Weld

THOROUGH TESTS were conducted on each four-ton pipe length for the new Springfield, Mass., water system before it was hauled from the Walsh Holyoke Steam Boiler Works. Every section was welded with G-E electrodes and then subjected to severe fatigue and bending tests. Every pipe length went into the hydraulic testing machine. Every seam was proved a sound, tough weld.

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A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.

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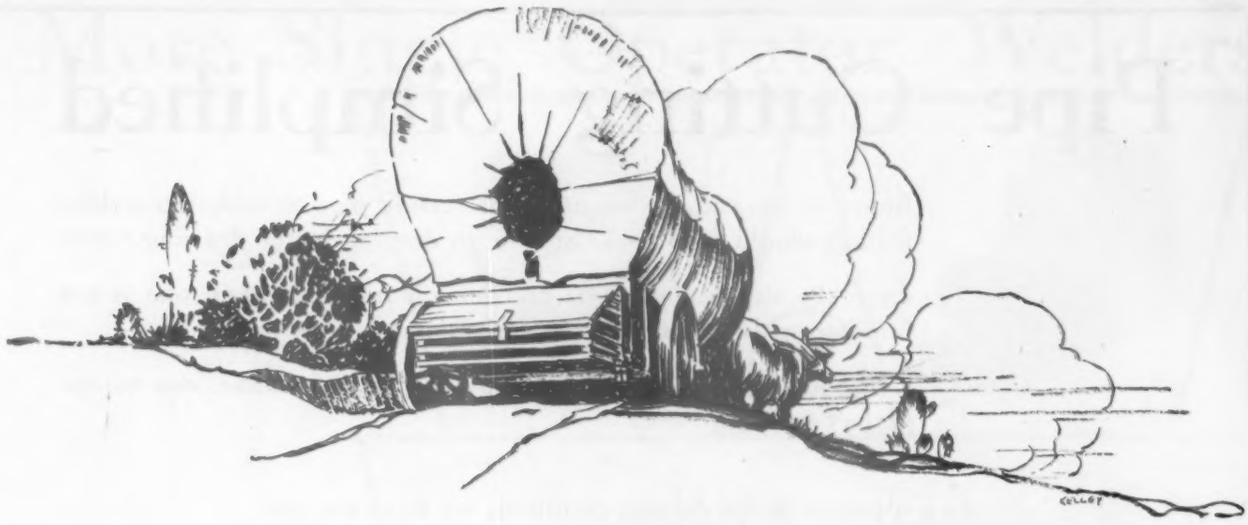


Pioneering courage

WHEN an industry has become great, one is likely to forget that in the beginning the odds were overwhelmingly against it and that its very life depended on one thing—the courage of the men behind it.

So it is with Union Carbide. The dramatic accident of the discovery of calcium carbide, by men who later founded the Union Carbide Company, fired their imaginations with its great industrial possibilities.

Difficulties must have seemed insuperable. Yet in the face of these odds a process that would yield uniform and high quality product was developed, new uses for carbide and its child acetylene were discovered and equipment that would make these uses practical was invented.

Today, the great welding and cutting industry with its innumerable applications, the thousands of farms lighted with acetylene and the cheap and efficient mine and marine lighting systems, are a few of the things that stand as monuments to the pioneer courage that made them possible.

UNION CARBIDE SALES COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

Carbide and Carbon Building, 30 East 42d Street, New York

Peoples Gas Building, Chicago, Ill. Adam Grant Bldg., San Francisco, Cal.

UNION CARBIDE WAREHOUSES IN 230 CITIES

Pipe Cutting Simplified

Many of the patterns required for cutting pipe to make up welded fittings would take hours of time to develop in the drawing room.

Even the simplest patterns are difficult to make when one is not familiar with the principles of mechanical drawing.

Consequently, welded fittings may be costly to make, due to imperfect cutting.

As a solution of the cutting problem, we have for sale a complete set of full size blue prints of curves, which enable you to cut your connections *correctly and accurately* the *first* time.

THIS SET INCLUDES THE FOLLOWING CONNECTIONS:

PIPE PATTERNS
2" 3 Piece Ell
2" 45° Ell
2" Rt. Angle Ell
2" Lateral
2" Round End
2" Tee
3" 3 Piece Ell
3" 45° Ell
3" Rt. Angle Ell
3" Lateral
3" Round End
3" Tee
3" Y
3" Split Bull Plug
4" 3 Piece Ell
4" 45° Ell
4" Rt. Angle Ell
4" Lateral
4" Round End
4" Tee
4" Y
4" Split Bull Plug
6" 3 Piece Ell
6" 45° Ell
6" Rt. Angle Ell
6" Lateral
6" Round End
6" Tee
6" Y
6" Split Bull Plug
8" 3 Piece Ell
8" 45° Ell
8" Rt. Angle Ell
8" Lateral
8" Round End
8" Tee
8" Y
8" Split Bull Plug
10" 3 Piece Ell
10" 45° Ell
10" Rt. Angle Ell
10" Lateral
10" Round End
10" Tee
10" Y
10" Split Bull Plug
12" 3 Piece Ell
12" 45° Ell
12" Rt. Angle Ell
12" Lateral
12" Round End
12" Tee
12" Y
12" Split Bull Plug
4x3 Tee
6x3 Tee
6x4 Tee
8x6 Lateral
8x3 Tee
8x4 Tee
12x3 Swedge Nipples
12x4 Swedge Nipples
12x6 Swedge Nipples
12x8 Swedge Nipples
12x10 Swedge Nipples
10x3 Swedge Nipples
10x4 Swedge Nipples
10x6 Swedge Nipples
10x8 Swedge Nipples
8x6 Swedge Nipples
8x4 Swedge Nipples
8x3 Swedge Nipples
6x4 Swedge Nipples
6x3 Swedge Nipples
4x3 Swedge Nipples
3x2 Swedge Nipples

CASING PATTERNS
5 3/16" 3 Piece Ell
5 3/16" 45° Ell
5 3/16" Rt. Angle Ell
5 3/16" Lateral
5 3/16" Round End
5 3/16" Tee
6 5/8" 3 Piece Ell
6 5/8" 45° Ell
6 5/8" Lateral
6 5/8" Round End
6 5/8" Tee
8 1/4" 3 Piece Ell
8 1/4" 45° Ell
8 1/4" Lateral
8 1/4" Round End
8 1/4" Tee

ODD SIZE TEES
5 3/16Cx3" I. D. Tee
5 3/16Cx4" I. D. Tee
6 5/8Cx4" I. D. Tee
6 5/8Cx3" I. D. Tee

With these curves you can make patterns for any of the above on any desired material, without the use of mathematics or drawing instruments. They will save many times their cost.

Price $20.00

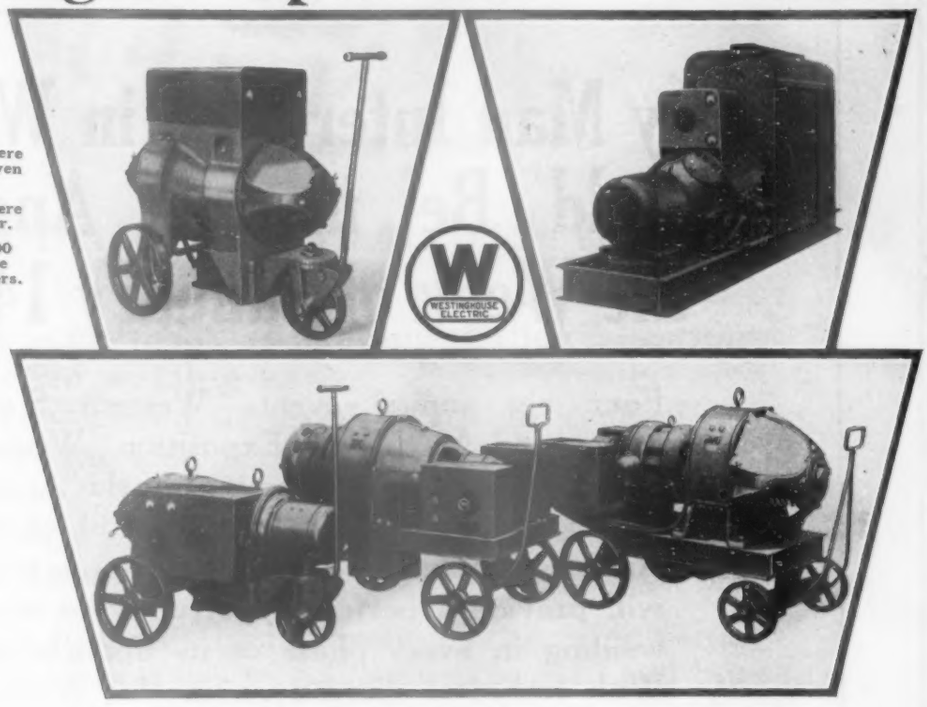
An Opportunity for Job Welders

These patterns will enable you to make up welded pipe fittings, which will be better and cheaper than cast fittings. This new and profitable line of business is a fine possibility in every locality.

The Welding Engineer

608 S. Dearborn Street
CHICAGO, ILLINOIS

More Single Operator Welders



Right—200-ampere Gas Engine Driven Welder.

Left — 300-ampere d-c.—d-c. Welder.

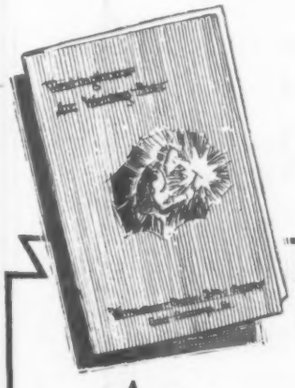
Below—200, 300 and 400-ampere a-c.—d-c. Welders.

Join This Group

CONSISTENT with the policy to supply modern welding machines for modern arc welding, Westinghouse has recently placed additional single-operator sets on the market. The latest welding sets offered are the 200 and 300-ampere d-c.—d-c. machines, and the 200-ampere gas engine driven sets. These, with the a-c.—d-c. sets shown, complete the Westinghouse line of single-operator welding machines.

All the speed in operation, all the efficiency over the entire operating range, and all the stability that characterized Westinghouse welding sets in the past, are embodied in these machines--PLUS new mechanical features that make for low maintenance costs and increased production.

Westinghouse also offers automatic welding machines, multiple operator equipment, and a complete line of welding accessories.



Arc Welding Data

Separate series of bulletins are available for

Executives
Engineers
Production Men
Welders

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

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Every Man Interested in Welding Should Be in Los Angeles the Week of January 14th

Four big annual events—Western States Metal and Machinery Exposition, Western Metal Congress, and Meetings of the American Society for Steel Treating and of the American Welding Society all in this one week will provide a perfect opportunity to study welding in every phase of its applications. With technical discussions at the Welding Society sessions, and with exhibits of welding apparatus and actual demonstrations of all of the welding processes, there will be something of interest to every man interested in welding from any angle. You have never had such an opportunity to combine a study of the latest welding developments with a vacation trip to the Land of Sunshine.

There are a few exhibitor's spaces left. If you wish to exhibit, please rush your reservation.

Shrine Auditorium Los Angeles

Special Train—Special Rates—With Stopovers

For those coming from the East, special round trip rates have been arranged, with the return trip optional via several routes, including a stop-over at Grand Canyon. For information regarding transportation, or reservation of exhibitor's space, write

W. H. Eisenman,

Director, Western States Metal & Machinery Exposition

665 W. Jefferson St., Los Angeles, Calif.

January 14th to 18th 1929

Quasi-Arc

AN ADVANCED, DISTINCTIVE DEVELOPMENT IN WELDING

Industry is gradually awakening to the realization that electric welding has far greater possibilities than have yet been achieved. With this realization has come the conviction that ordinary bare or paste-covered welding wire cannot keep pace with the higher development and progress of steel construction.

Engineers in general have come to the conclusion that the solution lies in a suitable covered rod but many have felt that such a rod must necessarily be almost prohibitive in cost, and practical only on special work.

QUASI-ARC is disproving that theory

Quasi-Arc Electrodes are designed in accordance with vital metallurgical principles. The special Yarn Covering forms a slag which protects the weld metal from attack by atmospheric gases, thus producing a pure weld metal of uniform high quality. The purity of Quasi-Arc welds provides unequalled ductility and resistance to corrosion. In combination with these quality features, speed and ease of welding make the application of Quasi-Arc Electrodes for all class of work most economical.

A practical demonstration in your own shop will not obligate you in any way. Why not write us?

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Sole Manufacturers of Quasi-Arc Electrodes and Welding Equipments and Consultants in Reference to their Application

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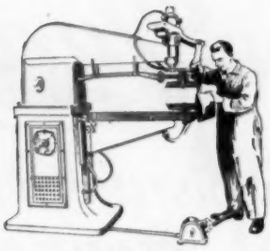
HARRISBURG, PA. CHICAGO, ILL. CLEVELAND, O. PORTLAND, ORE.

No matter what kind of welding you do--

OXY-ACETYLENE

ELECTRIC ARC



RESISTANCE

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YOU NEED

The Welding Encyclopedia

New Sixth Edition

It describes in detail the theory and practice of every welding process.

It tells how to weld every weldable metal by each of the welding processes.

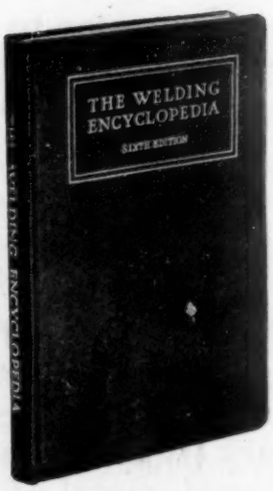
It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc.

It tells how to prepare parts for welding.

It tells how to install and care for welding equipment.

It explains the meaning of all words and terms found in welding literature.

It tells where to buy standard makes of welding apparatus and supplies.



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645 Illustrations
Flexible Leather Grain Binding
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3. Electric Arc Welding.—Complete instructions for welding all metals, studding, cutting, etc.
4. Electric Resistance Welding.—Includes Butt Welding, Line Welding, Percussion Welding and Spot Welding.
5. Thermit Welding.—The most complete treatise on this process ever published.
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8. Complete chapters on Pipe Welding, Rail Joint Welding and Tank Welding, explaining procedure in detail.
9. Rules and Regulations.—What can be welded and what cannot be welded. Rules also govern the installation and operation of equipment.
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The Sixth Edition contains much new and valuable data on Bronze Welding, Structural Welding, Welding of Stainless Steels, Resistance and Thermit Welding, Rail Bonding, and Design Data for Production Welding.

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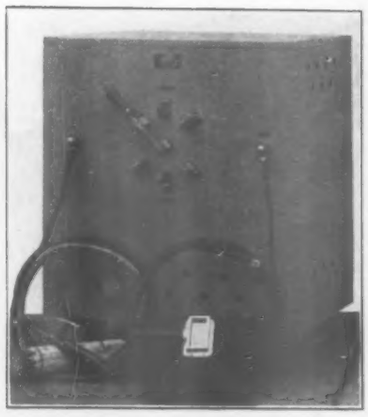
ARC WELDING MACHINES

have given complete satisfaction to the many users for years and years, at no maintenance cost.

You will buy them, too, on comparison with other machines, because of the superior design, construction and efficiency of operation, especially on cast iron welding.

We will gladly demonstrate on approval or on competitive basis at any time. In justice to yourself take advantage of this offer.



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Any voltage of A. C. power direct from your power line. 260 Amp. Price $750.00.

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For the welding shop or plant maintenance where requirements are not so severe. 200 Amp. Price $450.00.

Bulletin No. 8 describes our complete line of gasoline driven machines

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80 ELKONITE* WELDS ON EVERY LINCOLN WHEEL!

10,000 WELDS Per Set of ELKONITE DIES!

IMPACT TEST ON DIFFERENT TYPES OF AUTOMOBILE WHEELS

Impact	Load in Foot Pounds	Lincoln	A	B	C
1.	200	.009	.023	.038	.015
2.	220	.009	.026	.045	.026
3.	240	.010	.032	.074	.041
4.	260	.012	.034	.083	.058
5.	280	.016	.039	.094	.083
6.	300	.019	.048	.109	.102
7.	320	.024	.062	.164	.153
8.	340	.033	.066	.193	.202
9.	360	.042	.072	.286	.261
10.	380	.050	.092	.504	.335
11.	400	.054	.106	.608	.417

ELKONITE is the only welding material which can be economically used on the new Welded Spoke Lincoln and Ford Wire Wheels. Hard Copper and various alloys fail at once but Elkonite Dies give 10,000 perfect welds!

Never in the history of welding has there been a more outstanding success. And Elkonite welds are strong! Compare the impact deflection on the Lincoln Welded Steel Spoke Wheel and A, B and C, representative wheels of other types including Artillery, Disk and threaded spoke and nipple type of wire wheel.

Deflection is measured in inches at equally spaced points on rim, but only reading at point of maximum deflection is given. Eleven blows were struck, the first being 200 foot pounds and the last 400 foot pounds.

See the table at the top for detailed data on the wheel as furnished by the manufacturer—conclusive proof of Elkonite superiority.

Let our engineers show you how Elkonite can be used effectively in your resistance welding—no obligation of course.

DATA ON LINCOLN WELDED SPOKE WHEEL

Spokes per wheel	40
Diameter of Spoke	3/32"
Rim	Drop Center
Hub Shell	One Piece
Number of Welds	80
Primary Volts	440 A.C.
Primary Amperes	400
Secondary Volts	6
Secondary Amperes	12,000
Actual Welding Time	1.2 Second

The wheel is welded in eight operations of ten spokes to each operation, there being 40 spokes and each spoke welded on both ends, making a total of 80 welds per wheel.

The rim, hub shell, and spokes are located in place by special designed fixtures for each operation so that after the last operation the wheel is round and true.

This type of wheel is over 20 per cent lighter than a wire wheel of the threaded spoke and nipple type.

ELKON, Inc.

Division of P. R. Mallory & Co., Inc., 350 Madison Ave., New York.

*Reg. U. S. Patent Office.

Roebling

IN the large important steel works; shipyards; industrial plants; mines; automobile shops; railroad shops and repair shops, Roebling Welding Wire is demonstrating its efficiency and reliability.

Roebling electrodes are positively uniform in quality throughout the same shipment and throughout all shipments. They make the strongest, toughest welds with the least amount of trouble in welding.

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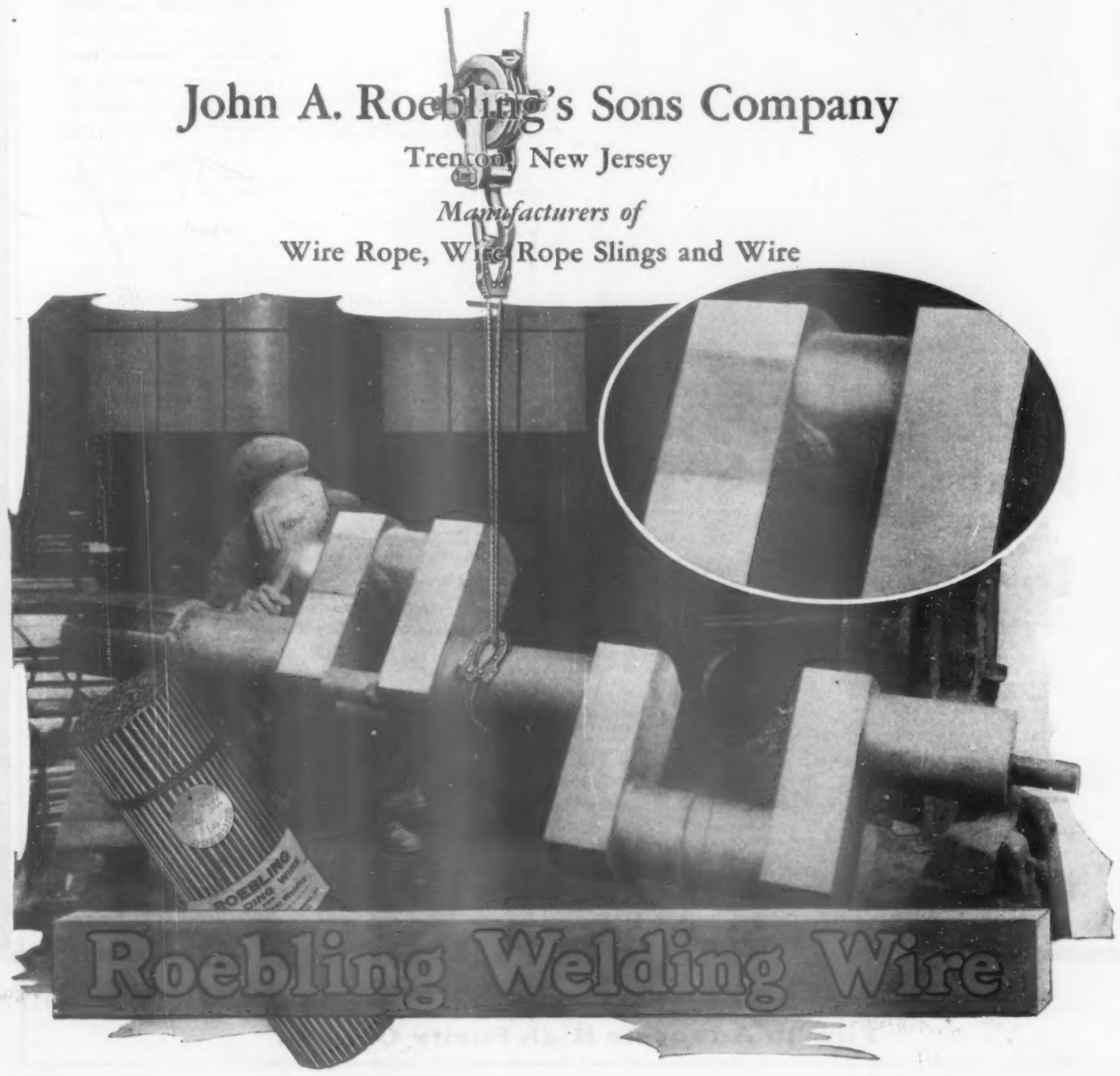

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Members of the Gas Products Association can give you prompt and efficient service from over 100 plants and warehouses located throughout the country.
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Eureka—California Compressed Gas Co.
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Long Beach — California Compressed Gas Co.
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San Diego — California Compressed Gas Co.
San Francisco—California Compressed Gas Co.
San Jose — California Compressed Gas Co.
San Luis Obispo — California Compressed Gas Co.
Sausalito—California Compressed Gas Co.
Santa Barbara — California Compressed Gas Co.
Santa Rosa — California Compressed Gas Co.
Stockton—California Compressed Gas Co.
Taft — California Compressed Gas Co.
Tracy — California Compressed Gas Co.
Ventura—California Compressed Gas Co.

COLORADO
Denver—Colorado Compressed Gas Co.
Pueblo — Colorado Compressed Gas Co.

DELAWARE
Wilmington—Paschall Oxygen Co.

GEORGIA
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KENTUCKY
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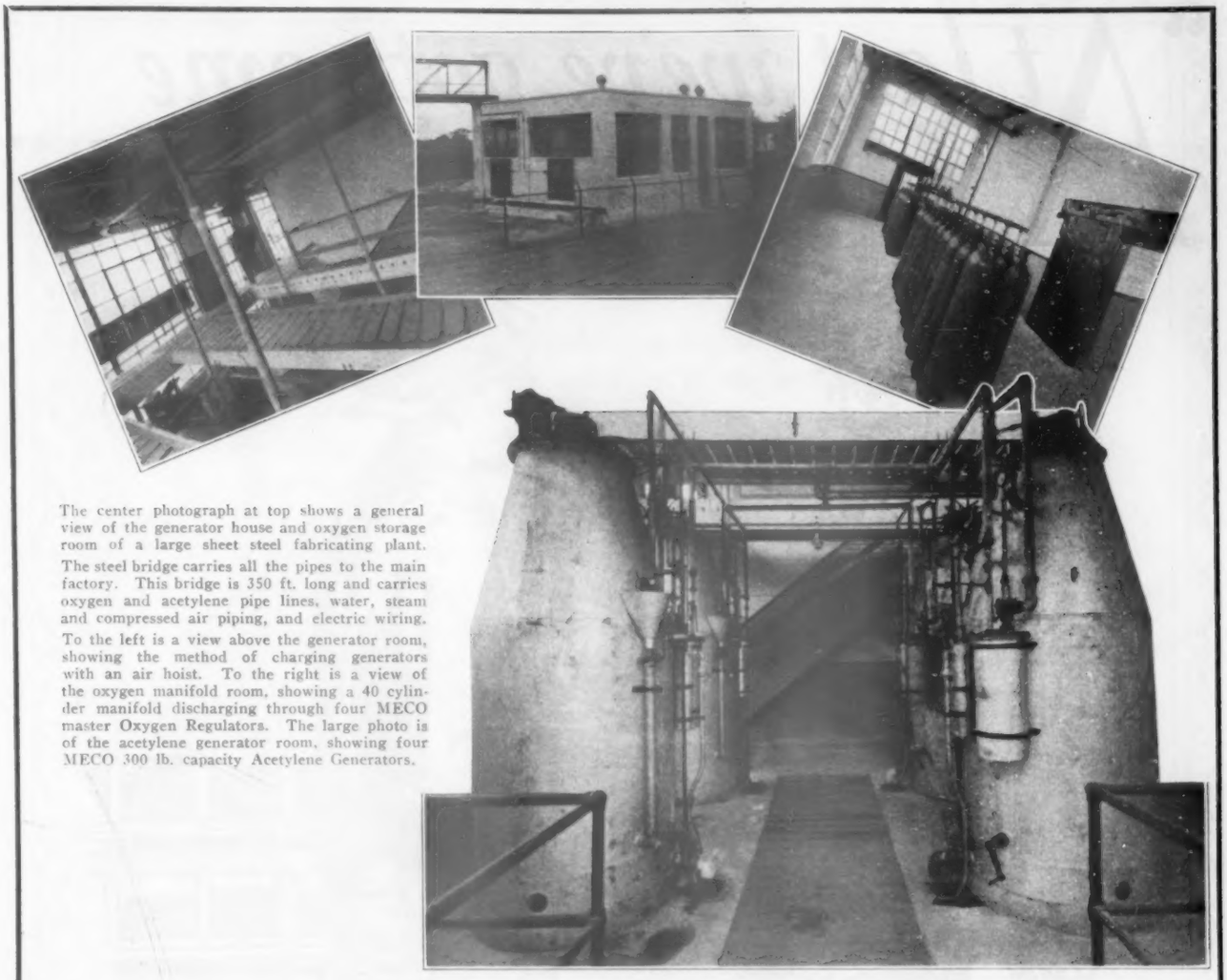
BOLD FACE TYPE signifies Manufacturing Plants.
LIGHT FACE TYPE indicates warehouses.

Gas Products Association

333 N. Michigan Ave. Chicago, Ill.

First to Advocate High Purity Oxygen



The center photograph at top shows a general view of the generator house and oxygen storage room of a large sheet steel fabricating plant. The steel bridge carries all the pipes to the main factory. This bridge is 350 ft. long and carries oxygen and acetylene pipe lines, water, steam and compressed air piping, and electric wiring. To the left is a view above the generator room, showing the method of charging generators with an air hoist. To the right is a view of the oxygen manifold room, showing a 40 cylinder manifold discharging through four MECO master Oxygen Regulators. The large photo is of the acetylene generator room, showing four MECO 300 lb. capacity Acetylene Generators.

Quality Equipment Backs the Production of a Quality Product

Meco

ACETYLENE GENERATORS

Approved by The Underwriters

ONE of America's most famous makers of quality products depends on oxy-acetylene welding for quality joints. Above is pictured the acetylene supply of one plant. This equipment is installed on the principle that quality assures highest performance.

Perhaps you should be using a generator in your work. If so we will be glad to show what we can do for you, on the basis of your immediate requirements. Note especially that in a MECO generator you get smooth, uninterrupted gas production, at a considerable saving. Write for complete details.

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"HERE'S a wire I like," said the welder. "It's fast and always uniform, and it certainly is easy to make a good weld with it. It gives good penetration and the arc is not wild. It's what I call Honest to Gosh wire because it runs so smooth."

And the boss knew he was telling the truth because the operators were not kicking about the wire any more. He knew, too, that this Hollup *uniform* wire had speeded up welding more than any other wire they had ever used—and labor cost is the biggest cost in welding.

First, of course, they made a trial of Hollup *uniform* wire—they did this by placing a trial order under our satisfaction-or-money-back offer. The wire did the rest.

You, too, have this same opportunity to do better welding with better wire. Or, if you prefer trying out a sample lot, send in your request—but remember that you don't take a single chance. We take all the risk, if there is any.

Hollup uniform quality welding wire should be on your payroll. You'll find it one of the best workers there.

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C. H. Hollup Corporation
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THE ELECTRONIC TORNADO

A process of automatic arc welding which represents a distinct advance in the welding art

THE Electronic Tornado Process of automatic carbon arc welding is now available for manufacturers of tanks, boilers, steel pipe and any products where steel is to be joined to steel on a production basis.

Welds made by this process develop greater strength and are more ductile than welds made by any other commercial process. Welding speeds are greater than by other welding methods, and this process is adaptable for either light sheet or heavy plate.

Since welding speeds are high the cost per foot of weld is low. On ½″ plate the rate of welding is 25 feet per hour and the cost is lower than by any other known method.

The crystalline structure of welds made by the Electronic Tornado Process is remarkably fine and uniform and the metal in the weld is actually superior to the parent metal.

Microphotographs of sections through the fusion zone show a gradual transition from the crystalline structure of the parent metal to that of the weld metal. In no place is the metal weakened by the welding process.

Space does not permit a description of the process itself. However, a descriptive bulletin covering the Electronic Tornado is available and will be sent on request.

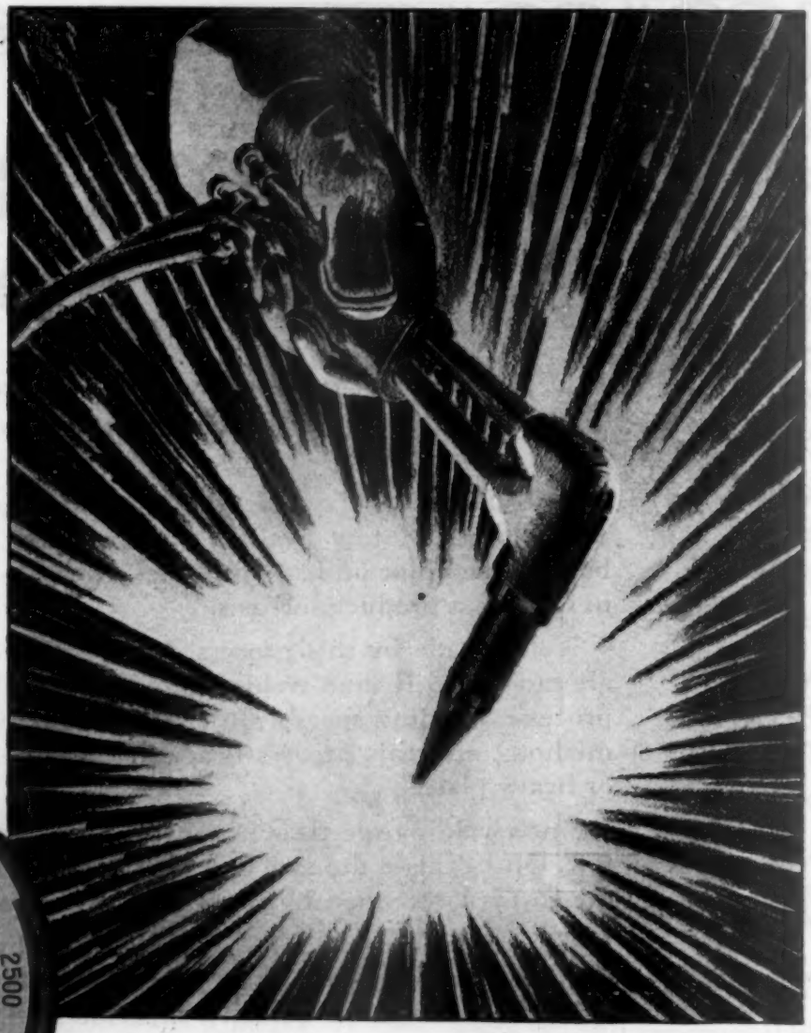
J. F. Lincoln

Vice President and General Manager

THE LINCOLN ELECTRIC COMPANY

CLEVELAND, OHIO

The Gauge.. that has stood the acid test of *use*



THE welding gauges you use should pass two tests. One you think of naturally; do they bear the approval of the Underwriters Laboratories? (Natweld Gauges do).

The other, however, is much more important. Do they bear the approval of the users, under every condition of actual service? (Again, Natweld Gauges do).

It is the acid test of use that makes or breaks a product. Natweld Gauges have come through every acid test of use with flying colors.

As a result the great demand for Natweld Gauges from users all over the world has made possible a volume of production that brings the price remarkably low.

An experienced corps of engineers is maintained to assist users in selecting the proper type of instrument for their equipment. You are urged to use this service.

Represented in Illinois, Indiana, Wisconsin, Minnesota, Missouri by Joseph Halla, 333 No. Michigan Ave., Chicago

Chicago Office, 820 Tower Court (MotoMeter Co. of Canada, Ltd.)

Eastern Office, 15 Wilbur Ave., Long Island City, N. Y.

National Gauge & Equipment Co.

La Crosse, Wisconsin

Division of the MotoMeter Co., Long Island City, N. Y.

EDITORIAL

An Interesting Expression of Opinion

ALTHOUGH there have been many indications of the progress of aviation during the past few years, such as the increase in air mail service, the rapid increase of passenger service, and the many announcements of new factories for aircraft manufacture, the most striking indication is the tremendous attendance at the airplane exposition which has just closed in Chicago. It was reported that over 20,000 people attended the show on the opening day and these were practically all paid admissions. The admission price was fairly steep for an event of this sort, that is, just for the privilege of looking at specimens of modern aircraft. Still this did not prevent huge crowds from turning out to see all that there was to be seen. This demonstration of popular interest in flying can be taken as a fairly certain sign that the promotion of flying in America has the moral support of the masses and anything which has popular backing in the United States is pretty certain to make progress. All this is, of course, encouraging to the welding industry because as far as airplane construction is concerned the welded joint holds a place of undisputed popularity. This rapid growth of airplane construction will, however, increase the use of welding in many other ways besides the construction of the planes themselves. Hangars will be in great demand and are best made with welded steel frames. The same is true of towers for guide lights and supplementary buildings.

A Valuable Aid to Research

EVIDENCE of the importance of the Bureau of Standards to the progress of the welding industry is found in the annual report of the Director of the Bureau of Standards for the year ending June 30th. Almost from the beginning of welding, different firms and organizations in the industry have had to call on the Bureau of Standards for assistance and invariably the Bureau has done its share. It should be remembered that two very important pieces of work are being aided right now by the Bureau. One of these is the investigation of rail joints which promises to develop standards of practice which will give better joints in the future. Another is the elaborate series of tests which have been made and are being made on welded steel structures. Tests have been made of a considerable number of welded structural details in cooperation with steel fabricators to determine the safety of proposed types of construction. These include girders, columns, shelf angles and other joint details, many requiring the use of the 10-million-pound testing machine. The organization merits the hearty thanks of the welding industry for the splendid work it has done and continues to do.

Welding Is An Opportunity

AS THE use of welding for pipe line installations in large buildings becomes more and more in demand, the attitude of labor organizations in large population centers becomes increasingly important. In quite a number of cities it has become evident that steamfitters recognize the usefulness of the welding torch to them as a standard piece of equipment. Accordingly, the labor organizations have adopted various methods to arrange for the training of journeymen in the fundamental principles of welding. In some cases, however, they are lagging behind the progress that others are making. A report was recently received that when a large national organization erected a new plant in one of the largest cities in the country the builders specified welding on all the piping. Local steamfitters had paid no attention to welding and had endeavored to hold back the demand for it, but in this case the desire to have a welded installation was so strong that union steamfitters who knew how to weld were imported from other cities, and the local men were cut out of a good job simply because they had neglected to become acquainted with up-to-date methods. However, in this case one lesson was enough. The local organization immediately got busy and made arrangements for welding instruction for its members so that future jobs of this sort could be handled by home talent. This same experience will probably be repeated a number of times unless steamfitters everywhere make up their minds to learn how to weld when it is necessary. There is no logical reason why steamfitters themselves should object to doing this or be slow in making their arrangements. Welding gives them an opportunity to do better work at no greater cost and to put in installations which will be free from a great many sources of trouble commonly associated with pipe lines installed by old-fashioned methods. It would in fact, reflect considerable credit on these men as a group if they took the initiative and prepared themselves to furnish welded installations of pipe on all kinds of buildings.

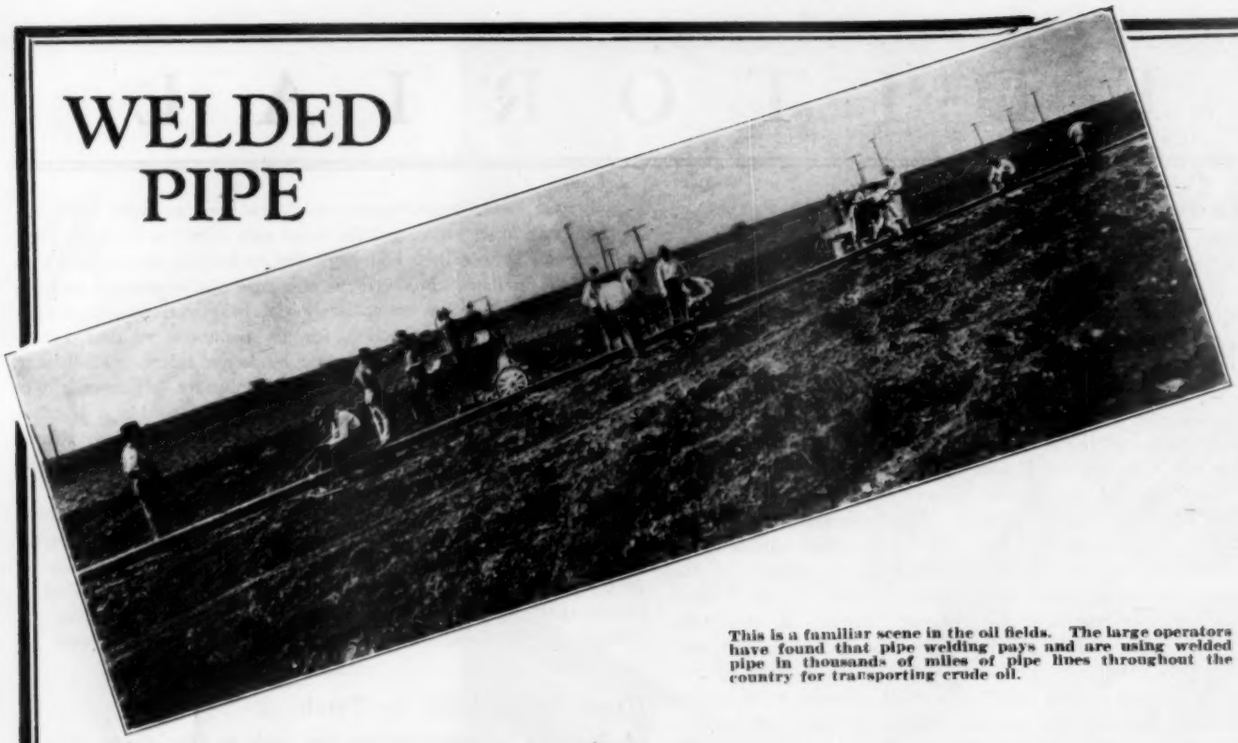
Heroic Deeds With the Torch

A SHORT time ago mention was made in these pages of articles recently published in one of our national magazines which explained why underwater cutting operations require so much time for making such short cuts. It was, of course, understood that in spite of the length of time required the underwater cutting torch still showed great economies over other methods of doing the work which might have been employed. However, one who has had an opportunity to read the complete series of articles referred to can scarcely fail to get another and perhaps stronger impression. There is something spectacular about the operation of the cutting torch, particularly when it is used in some place such as the frame work of a building or at the top of a hugh steel bridge where the fireworks show off to good advantage. But when one reads of the tremendous hazards encountered in using this marvelous tool many feet below the surface of the water, in total darkness, and under conditions which are thoroughly depressive, the man becomes more important than the tool. A good deal of the work done by the welders and cutters is of a sort of humdrum nature, still we often have cause to congratulate them on the great pride which they often show in their own workmanship. It is, therefore, interesting to learn that among the users of the torch there are men who, when the occasion demands a display of real heroism as well as pride of workmanship, have the stuff in them to respond to such a call one hundred percent.

To Standardize Government Needs

THE Government Printing Office at Washington is busy with the preparation of a Federal Standard Stock Catalog in which it is planning to list in an orderly and classified arrangement all supplies regularly procured, stored and isued by or for the various departments of the government and can furnish in the case of each item of such supplies the information necessary for procurement, storage and issue. It is intended that this catalog when completed shall include all items of supplies and materials necessary to meet the ordinary requirements of the various items, except in the case of special technical materials. While prepared primarily for the government service it is believed that its usefulness could be extended to the commercial field. For this reason it is planned to have copies of the catalog made available for general sale as soon as possible after the printing of the book is authorized by Congress.

WELDED PIPE



This is a familiar scene in the oil fields. The large operators have found that pipe welding pays and are using welded pipe in thousands of miles of pipe lines throughout the country for transporting crude oil.

ADVANTAGES OF WELDED JOINTS

Welding has three big advantages over threaded joints. First, welds will not loosen up in service; they stay tight permanently. Second, welds cost less than cast pipe fittings. Third, the power required to pump a fluid through a welded line is less than through a threaded line.

The same economies resulting from welding pipe lines can be realized by welding steam and water pipes in buildings. Several large all-welded installations have been made and a very active interest in the welding process has been aroused among steam fitters, plumbers and heating contractors.

A complete outfit for pipe welding, including a tool for oxygen cutting may be obtained for as little as $85.75. Write for details on this outfit.

Organizations and Technical Societies

We have available an educational movie on pipe welding which we will be glad to show at your meeting. This is a brand new film showing the application of welding in the heating and plumbing field.

The Bastian-Blessing Company

240 E. Ontario St., Chicago, Ill.

Los Angeles Prepares a Hearty Welcome for the Welders of the Far West

© Spence Airplane Photos

FOR several months the leading technical and engineering societies on the West Coast have been making preparations for the Western States Metal Congress, which is to be held in Los Angeles during the week of January 14th next. There is no doubt but that this event will be the most important and far-reaching conference ever assembled in the interests of the metal working industries of the Pacific Coast. Its attendance will be drawn largely from the membership of Western sections and chapters of the following national societies:

American Society of Mechanical Engineers
American Institute of Mining and Metallurgical Engineers
American Petroleum Institute
Institute of Metals
American Welding Society
Society of Automotive Engineers
Pacific Coast Electrical Association
Institute of Marine Engineers
Metal Trades and Manufacturers Association
Chamber of Mines and Oils
National Purchasing Agents Association
American Society for Steel Treating

Practically all of these organizations have in their membership lists men who are closely identified with the supervision of welding operations in their plants. The meetings held by the American Welding Society and the exhibits of important firms engaged in the manufacture of welding equipment and welding materials will draw to this event thousands of men who are perfecting their own welding operations and looking for new ideas and improved methods which they can take back to apply to their own work.

The field for welding in the Pacific Coast region brings into use practically every known application of every welding process. Among the outstanding industries which have made remarkable strides in the application of welding in that region are the ship yards, oil fields, oil refineries, railroads, lumber camps, textile mills, sheet metal fabricators, power plants, water supply protects, mines, canneries, airplane factories and packing plants. The use of welding is tied up so closely with the consumption of iron and steel that it is interesting to note that the consumption of iron and steel on the Pacific Coast is estimated at 3 million tons annually, with each year showing a 15 per cent increase over the preceding year. Sales of new machine tools approximate 5 million yearly and it is said that the manufacture of electric machinery, apparatus and supplies has practically tripled during the past five years.

There are so many uses found for all of the welding processes in this region that it would be out of the question to attempt a detailed listing of all the things which welding is accomplishing in that region. Many of the more important uses for welding, however, have originated there and been developed and perfected by local welders and engineers. Some close-ups of typical operations are to be found in the feature articles in this issue, which have been furnished from the Pacific Coast region. It would take a good many issues to give a complete picture of what the welders of the Far West have accomplished in the way of pioneer work and development work; solving their own problems and using their talents unsparingly to back up their faith in welding as a process of group of processes.

The Metal Congress and the Metal and Machinery Exposition will be held in the Shrine Auditorium in Los Angeles. The

program of activities is practically complete and it has been worked out in sufficient detail to assure a strong appeal to all users of metal.

In a region where welders have done so much for themselves it is to be expected that they will not miss this splendid opportunity to do a lot for one another. The executive committee in charge of these events has done everything in its power to assure the comfort and convenience of visitors, as well as provide events which will be well worth while as far as the cost in time and money is concerned. There has been much indication locally of a high degree of interest, according to all reports received so far. There is no doubt but that all those who attend will profit individually to a considerable extent. In a general way the returns from this meeting of men in the metal working industries will probably be very far-reaching. It is to be expected that there will be increases of the most modern metal working processes in this important territory. In other words, that the advancement of modern craftsmanship will be speeded up by this systematic interchanging of information and that another year will find greater progress made than in any previous twelve months period.

As stated above, the technical programs of this event will contain quite a bit of interest to the welding fraternity. On Wednesday morning, January 16th, the program will be sponsored by the American Petroleum Institute and one of the papers is on the subject of "Welding and High Pressure Gas Distribution." This paper is presented by C. J. Coberly, of Kobe, Inc. On Thursday afternoon the Pacific Coast Electrical Association sponsors the program which contains two papers relating to welding. "One of these is "Electric Heat as Applied to Industry," by C. L. Ipsen of the Industrial Heating and Welding Department of the General Electric Company. Another is on "Design as Applied to Arc Welded Construction," by G. D. Fish of the Westinghouse Electric & Manufacturing Company. Friday afternoon the program is entirely sponsored by the American Welding Society and contains the following papers:

"The Welding of Steel Buildings for Bridges," by Dr. Frank P. McKibben, Consulting Engineer for the General Electric Company.

"Heat Treatment with Oxy-Acetylene Flame," by J. J. Burton, Service Engineer, Oxweld Acetylene Company, New York.

"Building Machinery with arc Welded Steel Replacing Castings," by David Hall, District Engineer, Westinghouse Electric and Manufacturing Company, Los Angeles.

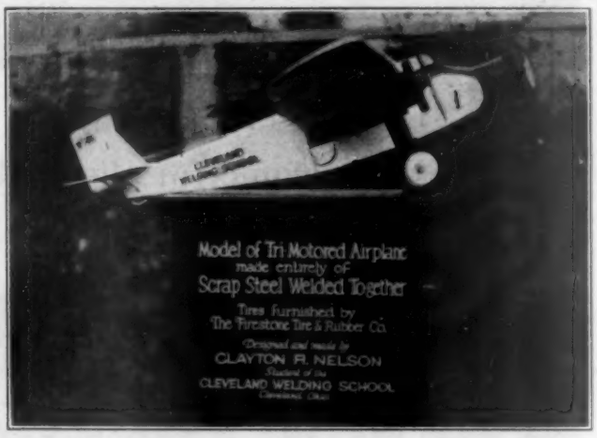
PRIDE IN STUDENTS' WORK IS JUSTIFIED

By R. K. Randall*

The writer contends that no school of any kind has any right to take credit for the ultimate success of any student. Any school, however, does have the right to take pride in any particular student's future and say, "We furnished the training facilities that made it possible for the student to train his natural academic or mechanical bents and thus helped him find his place."

Clayton Nelson took a welding course at our school and took it solely because of his intense interest in aviation and because he felt that the welfare of fliers was of paramount interest. Nelson felt that with welding being used as a method of fabrication for major parts of the ship, the fliers of the ships should be protected by having their welding done by men possessing a maximum of "job conscience." Upon completing his course, needless to say, he readily obtained employment in one of the large airplane plants.

His active interest in aviation and his mechanical genius were typified by building the plane that the pictures represent. This plane, made entirely of scrap steel picked up around school, has a wing span of 36 in., fuselage 24 in., and line of chord 7 in. This plane is equipped with driver's seats and all-welded steel seats in miniature for passengers. The tail and



All Welded Plane Made by Student Welder.

rudder are movable, the hinges on same being made of small welded parts. There are approximately 300 individual welds upon this plane, and these 300 individual welds represent approximately 500 in. of steel welding.

This plane has been exhibited in many of Cleveland's

Clayton Nelson and the Plane He made from Scrap Steel.

prominent business places and never fails to draw a crowd. The only part of the ship that is made of wood are the three propellers.

It is the student of today who becomes the master of tomorrow's destinies even in welding.

Proprietor, Cleveland Welding School.

THE PHYSICAL PROPERTIES OF WELD METAL DISCUSSED

The Chicago section of the American Welding Society held its monthly meeting on Friday evening of December 7, 1928. The meeting was held as usual in the auditorium of the Engineering Building. Promptly at 7:30 two reels of film from the International Harvester Company were shown, these were entitled, "McCormick-Deering Industrial Power."

Following the pictures a very interesting lecture was given by Mr. J. B. Green, president of the Fusion Welding Corporation. The subject of the talk was "Fundamentals Which Control the Physical Properties of Weld Metal." All of the various properties of welds such as strength, hardness and resistance to corrosion were discussed. The significance of such fundamentals as complete fusion, chemical composition of the weld metal, blow holes, etc., was brought out and as a result there were presented some new ideas on the control of the physical properties of welds.

Water Line Welding—an Evolution*

Oregon Firm Has Spent Ten Years in the Development of Equipment and Methods for Producing Welded Pipe of Large Diameter

PIPING for water lines many miles in length has long been a construction problem of Pacific Coast districts, due to natural conditions of that country. The manufacture and installation of the pipe by welding has been developed in gradual steps, and the progress toward perfection has been consistent. The pioneer work and present activities of the Beall Pipe and Tank Corporation, of Portland, Oregon, in this field, give an interesting picture of the possibilities of welding when employed with good engineering talent.

"In 1915 we felt that there was a big opportunity for the manufacture of welded products on the north Pacific Coast," said Mr. J. S. Beall, president of the concern, in a recent interview.

"At that time welding was in very much of an experimental stage. We proceeded to develop welding in our shop, both oxy and electric, and our first efforts were put forth on the manufacture of electric arc welded pipe for hydraulic and dredge work and municipal water systems. We went through many trying ordeals in this development, both as to welding equipment and welders.

20-Inch to 25-Inch Water Supply Line, 30 Miles Long, Welded, Dipped and Wrapped. Built for City of Medford in January, 1927.

"In 1918 we convinced the city officials of Bellingham, Washington, that an electric arc welded pipe for part of their municipal water system would be a good investment. The results were that we sold them about 20,000 feet of electric arc welded water pipe, manufactured it, delivered it, and it was installed, and although the welding was very crude compared with what is being done now, and the thickness of the metal was lighter than it should have been, the pipe is yet giving an unusually good account of itself. This was the first installation of electric arc welded pipe for municipal water purposes on the Pacific Coast, and we have been told that it was the first installation for this purpose in the United States."

The welding of this pipe was all done by hand welders. The experience gained on this job taught the necessity and advantages of automatic welding for this class of work, and the company proceeded through its engineering department to try to develop an automatic welding head. Good progress was made, but about the time they had completed their design they found that the General Electric Company, who had been working along these same lines, had developed one, so they dropped their own efforts, and proceeded to buy a G. E. automatic welding head and devise their own equipment for the traveling of this head over the seams of the pipe.

The G. E. welding head was at that time in an experimental stage, also the equipment for the head traveling over the pipe was crude, but from these experiments possibilities for a big improvement in equipment for automatic electric welding were seen, and the possibilities for many lines which could be economically made by electric welding that had been made otherwise.

"We then turned our attention to the manufacture of electric arc welded pipe for municipal water systems, dredge and hydraulic work, and electric arc welded tanks for water, air, oil and gasoline, and proceeded to further develop automatic electric welding equipment for their manufacture," said Mr. Beall.

"During the last few years we have sold and manufactured several hundred miles of electric arc welded pipe for municipal water systems and dredge purposes.

"One of our first electric welded pipe jobs of consequence was a 34-inch diameter penstock for the Skagit River power project at Seattle, Washington, which has to operate under a 750-foot head.

"Two years ago we installed for the city of Medford, Oregon, about thirty miles of electric arc welded pipe in diameters from 18 to 24 inches, considerable of which worked under 600 and 700 foot head. This installation has given an excellent account of itself."

Other quite large installations were 12 miles of 30-inch pipe for the city of Eugene, Oregon. About 14 miles of electric arc welded pipe for the city of Bend, Oregon. About 12 miles for the city of Seaside, Oregon. In fact, this firm has furnished electric arc welded pipe during the last four or five years to forty or fifty of the cities and towns in the Northwest. Many of these towns have given their second, third and fourth orders for electric arc welded pipe, which in itself should indicate satisfactory results.

The Beall company also feature the manufacture of air compressor tanks, hydro-pneumatic tanks, and other types of pressure tanks. In the state of Oregon all of these pressure tanks must be inspected by the State Department before shipping out, and they believe they are safe in saying that during the last two years of inspection of several hundred tanks, they have only had two which showed defects on these shop tests by the State Department. They have also made a large number of very complicated electric welded fittings where formerly cast iron had been used.

In the course of this development work this company has devised and has patents on a number of very valuable pieces of equipment for economically welding pipe and tanks, one of them being a machine for automatically welding the circumferential seams of pipe and tanks without tacking.

"We still see much improvement which can be made in the present welding equipment," concluded Mr. Beall. "And we are constantly at work on these improvements in our mechanical and engineering departments with quite satisfactory success."

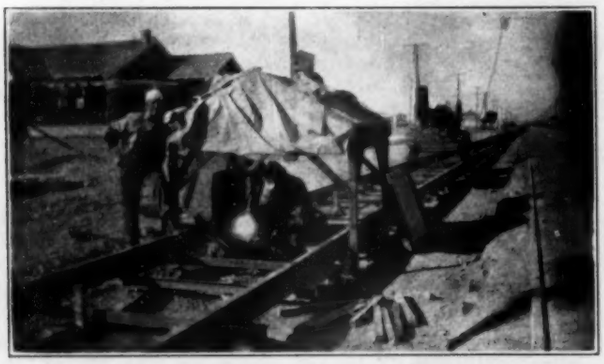
*From an interview with J. S. Beall, President, Beall Pipe and Tank Corporation, Portland, Oregon.

STREET RAILWAYS FIND WELDING INCREASINGLY USEFUL

By C. W. Fry, San Diego, Calif.

The San Diego Electric Railway Co. first began the use of electric welding in 1921. At that time they built their first carbon-arc welded track, of rigid steel tie construction. It extended from Third and Broadway, nine blocks west to the Union Station. The rails were 114 lb. Trilby rails.

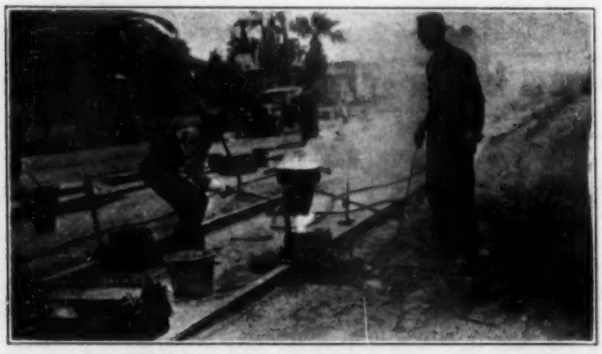
This city has over a hundred track miles of street railway; and in the last seven years practically all the main lines have been rebuilt. The steel-tie construction has been used, with either electric or thermit welded joints. On one line of this system, they have the in-bound tracks welded with carbon-arc, and the outbound with thermit. This gives an excellent opportunity to test and compare the two types of welding.



Carbon Arc Rail Welding.

San Diego covers a large area, being 22 miles north and south; six miles east and west. The traffic problem is rather a serious one to handle. The new and sparsely settled communities are now being covered with large buses of which there are now over twenty in operation.

All of the old type special work consists mainly of solid manganese. Previous to 1921 this was changed out when it became too badly cupped at the heads. But now, with recent



Thermit Welding 93-lb. Rail.

developments in electric welding they are built up with manganese rod, and are available for several more years of service.

After various experiments in building up manganese heads or cups, it was found that quenching the weld with water, and keeping it cool, gave the best results.

On the open-construction lines, the joints are all bonded with the 7-inch U bond, welded with electricity.

Before 1921 the car shops were forced to discard on the scrap heap all parts that were either badly worn or broken; and great loads of scrap were hauled away regularly. Now, with a new, modern welding shop, fully equipped with acetylene, thermit and electric welding, nothing is discarded. In this shop they make various experiments such as welding manganese switch points, thermit welded special work, brazing of cast iron, aluminum castings, etc.

The company has just completed a three months' reconstruction job on Imperial Avenue. This consisted of 75-lb. T rail, rigid type construction. Two crews of electric welders averaged from 18 to 22 joints per day. All the welded joints are ground with either a rotary or reciprocating grinder.

SERVICE OPERATOR AIDS IN REMOVING 650 TONS OF METAL IN GENERATOR DEMOLITION

For many years progress in the design of equipment for generating electricity has been along the lines of obtaining greater output from units of smaller size. Compared with modern plants, installations made 20 or 25 years ago are cumbersome and inefficient. Consequently as space becomes increasingly valuable and as operating costs get out of line with up-to-date practice, frequently it is necessary to scrap an entire plant containing equipment of huge proportions, whose removal often presents a serious problem.

A typical example is that of a 500-kw. generator in a power plant in the middle west. This was driven by a reciprocating steam engine, the entire unit requiring more than twice the floor space needed for a modern unit of equivalent capacity. But before a new unit could be installed, it was necessary to get rid of the old one. This was no small problem as the flywheel was 27 ft. in diameter and the other parts were proportionately large.

It is well recognized that cutting with the oxy-acetylene blowpipe or oxygen lance offers the only economically feasible method of doing work of this nature. This was appreciated by a scrap dealer who wanted to bid on the job of demolition, but was somewhat uncertain as to the ability of his operator to cut such heavy material. He got in touch with the manufacturer of his cutting blowpipes and was assured that the job could be done and that a service operator would show his own operator how to proceed. The contract was secured and the work of demolition began.

The rim of the 27-ft. flywheel was 21 by 31 in. in cross section, and it was necessary to make five cuts through the cast iron rim. Cutting time averaged 28 minutes per cut. After cutting out the links and cutting the spokes, the rim was removed in 10 pieces, each about 8½ ft. long, weighing about 8½ tons.

After removing the flywheel hub, crank discs, and other parts attached to the shaft, the steel shaft 36 in. in diameter was cut in 4 pieces, each 5 ft. long.

In all about 650 tons of metal were removed. With the help of the service operator, the cost and time of scrapping were reduced to a minimum, which naturally pleased everybody concerned.—*Oxy-Acetylene Tips.*

BOOK REVIEW

CHEMICAL PLUMBING AND LEAD BURNING, by E. B. Partington, covers in very thorough manner the subject of lead burning, particularly as applied to sheet work and plumbing, by all of the processes used, namely: Aero-Hydrogen, Oxy-Hydrogen, Oxy-Coal gas, Air-Acetylene and Oxy-Acetylene. The apparatus and procedure required by each process are described and the relative advantages and disadvantages of the various fuel gases discussed. The author appears to favor the use of acetylene, especially as an oxy-acetylene flame. The nine chapters cover, in addition, the advantages of lead-burning over soldering; preparation and making of seams and joints on sheet lead; pipe joints; chemical plant maintenance and repairs; lead-burning as applied to external plumbing, sanitary and domestic; oxy-acetylene lead-burning as applied to domestic plumbing, with further applications of the blowpipe; lead-burning as applied to electrical engineering. The volume is well illustrated with photographs and drawings. Published by Allen-Liversidge, Ltd., Victoria Station House, Westminster, S. W. I., London.

The "Whys" of Production Welding

Discussing Ten Advantages Realized by Production Engineers Who Employ Welding in the Fabrication of Metal Articles

By J. O. Bishop*

THE dawn of every art draws out new descriptions, descriptions of procedure in obtaining certain results, and descriptions of the results obtained. Necessarily these descriptions must call for the use of some new terms. With the dawn of the useful art of arc welding, which is just entering an era of healthy practicability, there has been a necessity for a name descriptive of an infinite number of objects made by the process of unifying two or more pieces of metal by welding. These objects might fill the place formerly occupied by castings, forgings, machine shaped pieces, or pieces fabricated by pressing together, screwing together, shrinking together or fastening together by rivets, bolts or screws. They might well replace objects of wood or concrete or, on the other hand, they might be objects made up

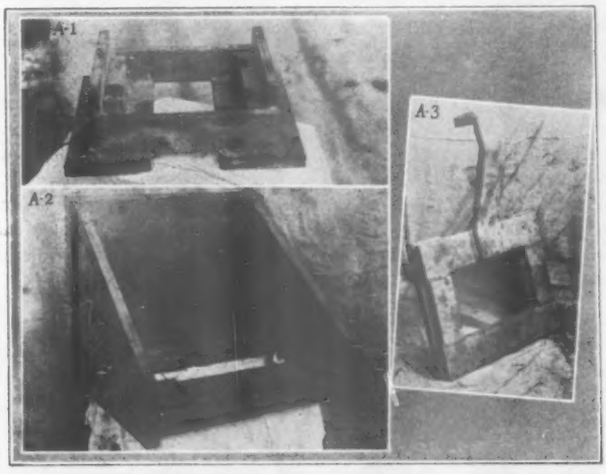


Fig. A-1—Drill Jig Made of Deeply Pitted Stock But Having Necessary Strength and Rigidity. Fig. A-2—A Durable Boring Fixture. Fig. A-3—Another Type of Drill Jig.

of a combination of any of the above yet there has been no name mentioned so far that is descriptive of these objects. With this in mind the name "Weldex" was hit upon and is used in either the plural or the singular. It seems to be descriptive as well as distinctive. The first syllable is self-explanatory and the second, "ex," or shortened to X, denotes . . . the unknown quantity; and the number of uses these Weldex can be put to, and the number of advantages they represent is certainly an unknown quantity.

Right here it might not be amiss to say a word in favor of welding in general. Volumes have been written in regard to this subject as opposed to riveting or bolting or, as compared to castings or forgings. No sane person would support the idea that any one would replace all of the rest, but it does seem that if welding had been the first art in the field there would be no question but that it would be universally accepted and used and to push any of the other methods forward would be a much more discouraging struggle than is that of promoting arc welding.

Some of the advantages realized by the acceptance and practice of the idea will be mentioned as follows:

First. Lower cost.
Second. Quicker service.
Third. Freedom from disagreeable surfaces to be machined.
Fourth. Possibility of machining almost or entirely inaccessible surfaces before finishing Weldex.
Fifth. Ease of alteration.
Sixth. Greater flexibility in designing.
Seventh. Greater strength.

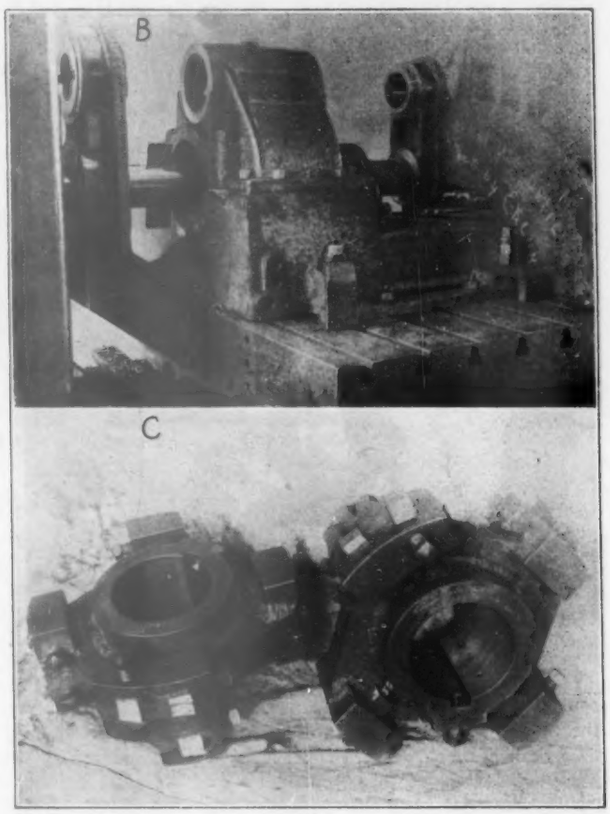


Fig. B—Reduction Gear Housing in Place on Boring Machine. Fig. C—A Mean Job Greatly Simplified by the Use of Welding.

Eighth. Adaptability of facing with extremely hard or non-ferrous metals for wearing purposes.
Ninth. The assurance of clearance in blind passages.
Tenth. Graceful design.

In explaining the first point, the actual mention of cost in dollars will be avoided inasmuch as there is considerable difference in wage scales, material prices, and overhead rates in various plants throughout the country. Also, let it be understood that this discussion is dealing principally with articles such as jigs or fixtures and machinery parts such as the average industrial plant requires only one of a kind. Now, to produce a casting let us pass over the usual procedure. After the designer delivers his drawings, the pattern makers make the patterns and core boxes which would be taken to the foundry and the cores would

*Master Mechanic, National Supply Co. of Calif.

be made and baked after which the principal mold would be made. When this much is completed and the molds are dried and closed the metal is poured and allowed to cool slowly. Iron castings are then shaken out and cleaned by hand or tumbling or sometimes sand blasted. Steel castings are shaken out, the gates and risers cut off, castings annealed and cleaned by hand after which they are sand blasted. After inspection at this stage all *surface apparent* defects are chipped out and welded, principally to afford a better appearance. The castings are then taken to the storage yard and are ready for machine operations. The patterns and core boxes are returned to the pattern storage where they are put away and, in many cases, are never used again due to the fact that commodities are constantly changing and, while new commodities have similar parts, they are usually altered so in dimensions that the old patterns are practically useless. The only

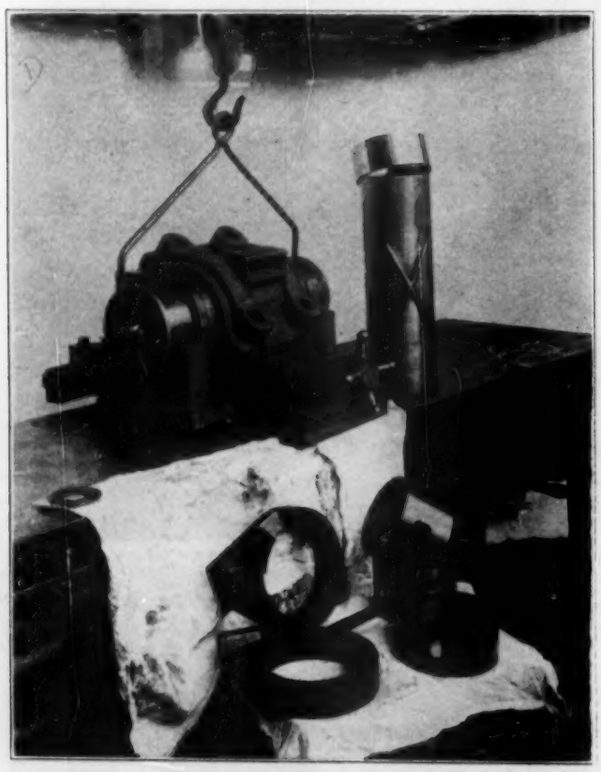


Fig. D—Babbitting Apparatus.

reasons for saving most of these patterns is for fear of damage to the casting in current use or the reluctance of one to discard a piece of handiwork. There is an intangible loss caused by the necessity of storage of this gross number of old patterns.

To duplicate this in Weldex, the drawings are turned over to a mechanic (either a tool maker or an advance machinist) who specializes in this class of work and understands advantageous design, welding practice, strength of materials, expansion or contraction due to heating or cooling, and subsequent machine operations as performed in the machine shop. He selects his material (in many cases remnants gathered from about the plant) and lays out the various pieces, allowing for any finishing operations which are to follow. An acetylene cutter then does his part, provided there are not reasons for other methods of cutting, and the tool maker then takes the pieces and performs such preliminary machining operations as are found necessary. This usually consists of squaring up one or more edges of the flat pieces so that there will be straight lines from which to do following operations, roughing out round or odd shapes which cannot well be cut with a torch, providing clearances around pads to make possible succeeding machining operations. The pieces are then usually brought together on a surface plate, the mechanic deciding in which manner it would be best to carry out the welding and will set up one piece on another and have them tacked together by a small localized weld. It is necessary that he exercise constant vigilance to keep all parts square and straight and otherwise workmanlike while this tacking is going on. After all the parts are assembled into what will be the Weldex, he instructs the welder how to proceed with the balance of the welding and goes about other work.

To give you some idea of the relative costs, it will be easy to point out a few facts. A pattern maker commands about the same wages as a tool maker or a good machinist and the welders about the same as molders, but, in many cases, it has been found

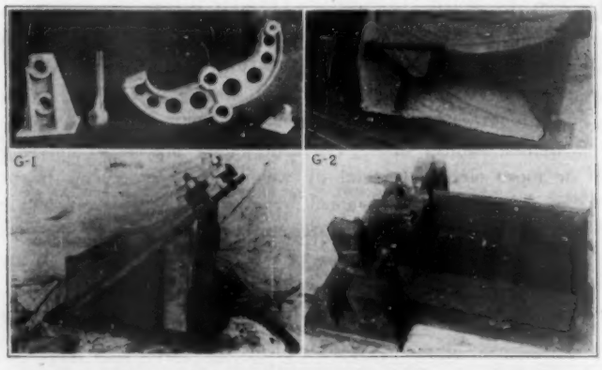


Fig. E—A Simple Cutting and Welding Operation Enabled This Fixture to Do Double Duty. Fig. F—A Unique Jib Crane. Figs. G-1 and G-2—A Couple of Husky Milling Fixtures.

that a Weldex can be made of steel parts, jointly by a tool maker and a welder, more quickly than the pattern with its core box can be made of wood. It is therefore obvious that the molder's time and the pouring crew's time are eliminated. Besides this, for estimating purposes, figure about three times as much for cast iron and six times as much for cast steel per pound as compared to the cost of mild steel universal plate or equivalent used in making Weldex.

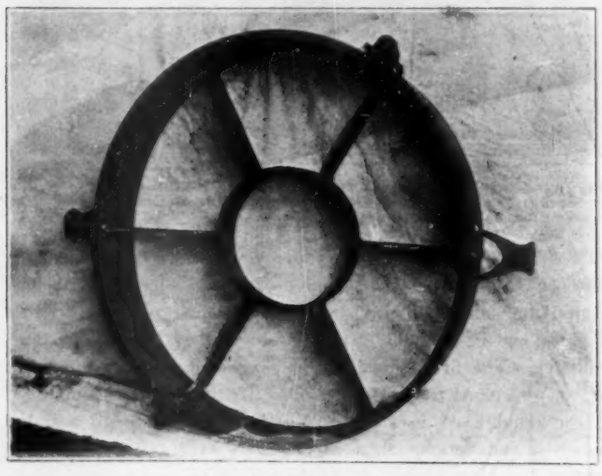


Fig. H—Foundry Flask.

This seemingly high ratio in costs for castings can be accounted for because of the fact that, in the first place, patterns must be made and paid for and are usually needed but once, and each molding job of this sort usually has its own peculiar characteristics and presents a little different problem to the molder than is usual on patterns which he is making day after day, consequently it takes him longer to mold up this sort of pattern.

Of course everyone knows that in pouring a casting a large percentage of the metal is poured as gates and risers which must be cut off and scrapped. On the other hand, there are certain scraps in cutting plates, but they are usually useful for other jobs. Ordinary universal plate or rolled stock runs in the neighborhood of three cents a pound and the cost of welding rod in

making Weldex is but a few cents, so it is easily seen that quite often one is able to furnish a Weldex completed and ready for the machine shop as cheaply as the actual pattern is made.

Some little difficulty will be experienced with Weldex if pains are not taken to relieve the strains set up in welding just as strains in castings are relieved by annealing or seasoning for months. The best results will be obtained by normalizing; that is, by heating in a furnace to about 1,500 degrees and then allowing to cool in the furnace. It will readily be noticed that this will also anneal any localized hardness at or adjoining the weld.

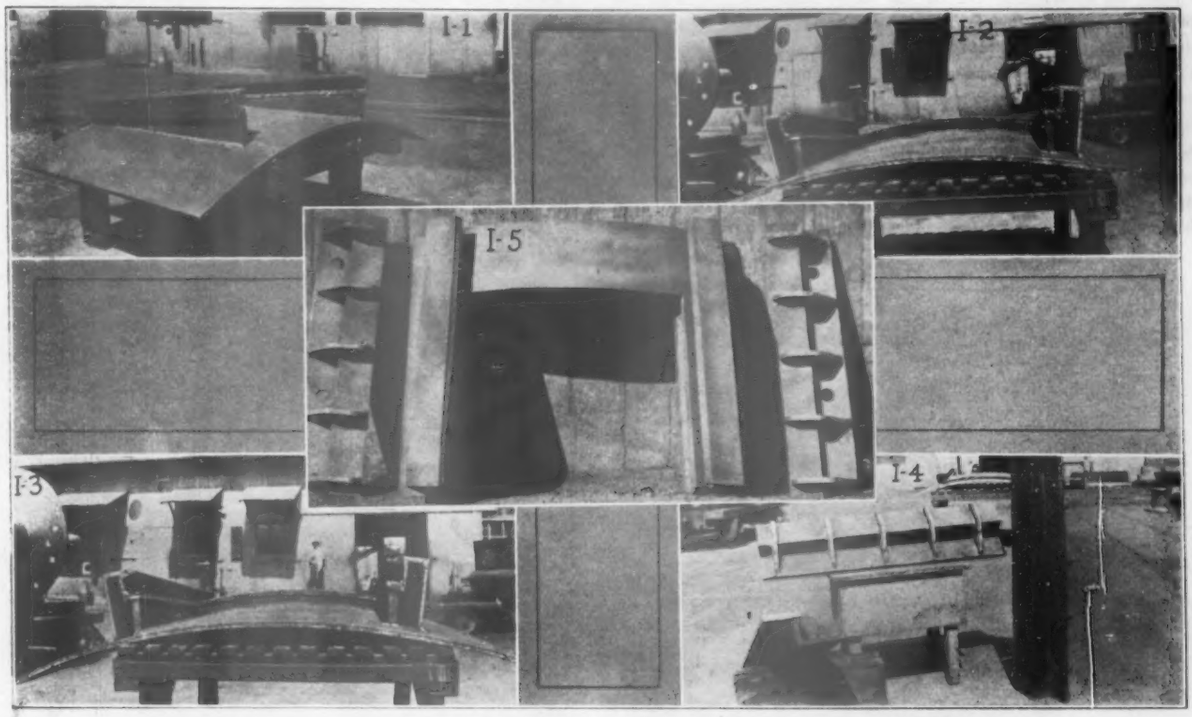


Fig. I—Evolution of Electric Furnace Door Arches, Showing Successive Stages of Welded Fabrication.

To illustrate the second point, that of "Quicker Service," visualize the usual manner in which a new commodity comes into the market. The average engineering department will make plans for some time and the different executives and engineers will examine these plans for weeks or months, making such changes as seem best, and finally when this has gone as far as is feasible and the management decides to proceed with the manufacture of the commodity, the drawings are usually taken to the pattern shop with the instructions to rush all possible. About this time those responsible for designing tools with which to machine any commodity are notified of this new commodity coming out and commence to design the necessary tools. Usually, by the time these tools are designed, the patterns for the commodity itself are practically finished after which it probably would be the case that the patterns for the tools would be started upon and by the time that the patterns for the tools are finished the castings for the commodity are ready for machine work and it is either a case of waiting for the tools or proceding on the castings by laying out and cut and try methods, a procedure which invariably runs cost far above the estimated figures for the job.

To illustrate this statement please observe a typical case. Some time ago a certain reduction gear was to be introduced. The tool designers received notice of the job as the drawings were turned over to the pattern shop. The tool designers made their drawings from the drawing of the reduction gear and orders were put out for the tools about the same time the pattern makers started on the patterns for the commodity. The tools were made in Weldex and were finished and ready for work by the time the castings came out of the foundry for the job. This lot of reduction gears went through on schedule and slightly below the estimated cost.

The third point mentioned was "Freedom from disagreeable surfaces to be machined." Any one who has been experienced in machine shop practice knows that it is very seldom that a casting is handled in a machine tool without running into sand pockets or chilled spots that cause trouble in machining operations. With the Weldex properly made and thoroughly normalized this does not happen. One is able to have a smooth, uniform rate of cutting speed higher than is possible on castings. He also finds that he can allow much less stock for finishing as the finished surfaces are usually even to start with.

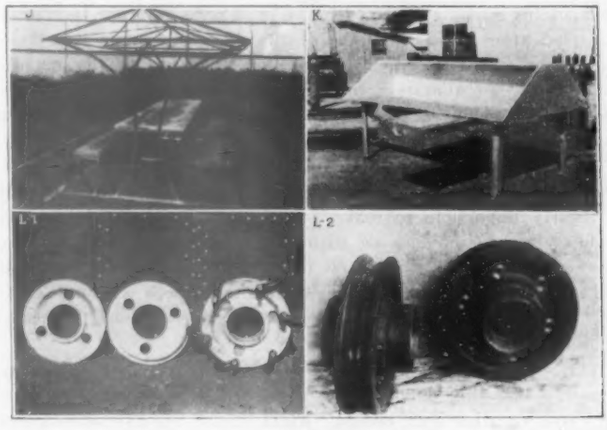


Fig. J—Lunch Table, Seats and Pergola Frame. All in One Piece. Fig. K—Double Coremaker's Bench. Figs. L-1 and L-2—Wheels Made Up of 2-inch Plate and Scrap Forgings.

As a fourth advantage, "Possibility of machining almost or entirely inaccessible surfaces before finishing Weldex," it can be pointed out that it is sometimes desirable to surface a certain

part of a Weldex before the remaining parts are attached thereto; for instance, a narrow deep pocket or a small square cornered hole or any other small surface that would cause no end of difficulties on a casting can be easily finished in this manner.

A good example of this idea is a boring cutter head, Figure "C," which is shown. This head was built up of two-inch plate with hubs on either side cut of the same material. Around the periphery are several pieces of two-inch square cold rolled steel which were machined previous to welding, having been sawed off a bar, set up in a milling machine and a milling cutter slightly wider than the size of the tools to be used was run through the blocks at a depth slightly greater than the thickness of these tools, thereby leaving a good square corner groove in the piece. After they were finished they were clamped with the open side of this groove against the two-inch plate and welded into place, leaving a perfectly square hole already finished. Any tool maker will readily appreciate this point if he has had to machine a

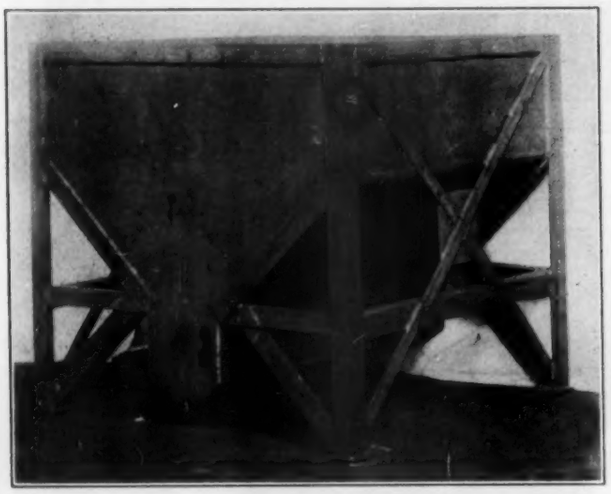


Fig. M—Bottom Dump Sand Box.

similar style of casting of which this head could be made. Two or three square holes of this kind in a casting would be a day's work whereas in this Weldex 18 square holes were finished in less than one day.

Fifth, "Ease of Alterations." Some one has said, "A wise man changes his mind, a fool never." For a wise designer to change his mind after he has seen the results of his design is sometimes very expensive especially as applied to castings, while, on the other hand, an alteration to a Weldex is always practical and inexpensive, relatively speaking. Adding a pad here or a brace there is common practice.

Number six, "Greater Flexibility in Designing." What engineer has not found in designing that it would be very difficult or nearly impossible to make a certain casting in a preferable manner due to molding or shrinking difficulties. With Weldex there is no worry about how the pattern can be drawn from the mold or, on the other hand, whether the piece will be a casting failure because there is a light section adjoining a heavy section.

The seventh point, that of "Greater Strength," will probably arouse a lingering doubt in the minds of some; some who have seen welding tried with failure. Right here a word of admonition for supervisors and welders alike will fit in. Welding has been condemned entirely too much through the thoughtlessness or ignorance. An executive, who would never dream of sending a molder forth to design and make his own patterns, will turn around and leave the design and construction of Weldex up to some novice who has learned to hold an arc. On the other hand these novices must remember that holding an arc is about the easiest detail to master in the art of welding. Continuous study and practice must be maintained by those who would let it succeed. After all, however, the strength of a Weldex is about the easiest job to control imaginable. Take two plates about a foot square and an inch thick, set one on edge across the middle of the other, stick a tack (a short weld) in each corner at each end. Those four tacks would suffice in strength for a certain purpose. A single bead could be run across in each corner angle and sufficient strength would be attained for another purpose.

Bead after bead blended into the others in each corner until a triangle with a forty-five degree hypotenuse and a base of half the thickness of the plate is formed in each corner and the T section thereby formed will be approximately as strong as a forged or cast T with sharp corners; not that the weld is claimed to be stronger metal but because in the welded job the strength is applied farther from the center of the piece or, in other words, farther from the fulcrum with the consequent advantage.

If a question of strength arises after a Weldex is completed, it is a simple thing to add strength by welding in webs or brackets or larger beads. If this same question arose with a casting the casting would probably wind up in the scrap, and another made from an altered pattern.

By way of explaining the eighth point, "Adaptability of facing with extremely hard or non-ferrous metals for wearing purposes," let it be said that all of the merits of hard facings can be realized when applied to parts exposed to severe duty on a Weldex just as on an oil well drilling bit or dredge teeth. Parts of dies are lined in this manner, as well as cam faces and similar articles.

Add to this the fact that non-ferrous metals are adaptable in many cases where rust or metal to metal chafing would be harmful. One-half of a metal friction clutch, faced with bronze, will prevent either half from cutting the other unduly; again, one part of a threaded fitting can be built up with bronze before the thread is cut, and, then, if exposed to rust, these joints will unscrew more readily than steel or iron joints.

Approaching the ninth advantage, "The assurance of clearance in blind passages," just recall some of the places where a clean clear passage is vital and at the same time how difficult it is to obtain in a casting with its sand, core wires, chapplets, not to mention core shifting during the pouring process. Water jacketed parts come within the scope of weldex admirably. Water cooled furnace parts such as doors, door arches, and buck staves are superior to castings in every way, they cost less and last longer and do not have to be as bulky to assure good circulation.

Another important consideration, the tenth, "Graceful Design," should be the possibility of beautiful or graceful designing afforded by Weldex. Structures, in which bolts, or rivets or other fittings would mar the outline, can readily be accomplished in this manner. Welding predominates in ornamental iron work, which is so popular at present.

A much clearer idea of application of the principles set forth above can be had from a study of the photographs which accompany this article. One or two of them have already been mentioned in the text and some of them are self-explanatory. Attention will, however, be called to interesting features of a few selected photographs from this group. Figure C, for example, shows how welded construction makes an easy job of a mean one. In this pair of boring cutter heads there are 4 roughing cutters, 4 finishing cutters and one counter-boring cutter in each head. The total is 18 square holes in the steel.

The babbitting apparatus shown in Figure D consists of an adjustable holding fixture; 2 mandrels, 2 pairs of shimming collars, 2 pairs of pouring collars and 2 pairs of separating liners, one pair of slotted washers and a bolt and lifting hook. The unique feature of this job is that the mandrels had the lubricant groove welts welded on them after the mandrels were ground to size. These mandrels are of tubing with end plates pressed in each end. They were centered, turned and ground to a diameter

a few thousandths over the shaft size of the boxes. A plate of copper (about ¼"x4"x8") was bent to the shape of the mandrel and clamped on. The whole was set up in a milling machine with spiral attachment and the cross was milled through the copper and slightly into the mandrel. The copper matrix was removed and its corners finished by hand. It was then re-clamped in position and the exposed portion of the grinding mandrel wrapped in asbestos packing. The welding was then performed through the matrix. On completion of the welding the matrix was cut off and the mandrel was set up again in the miller spiral attachment and surfaced to suit, except the corners which were finished by hand. There was practically no warpage or marring of the ground surface.

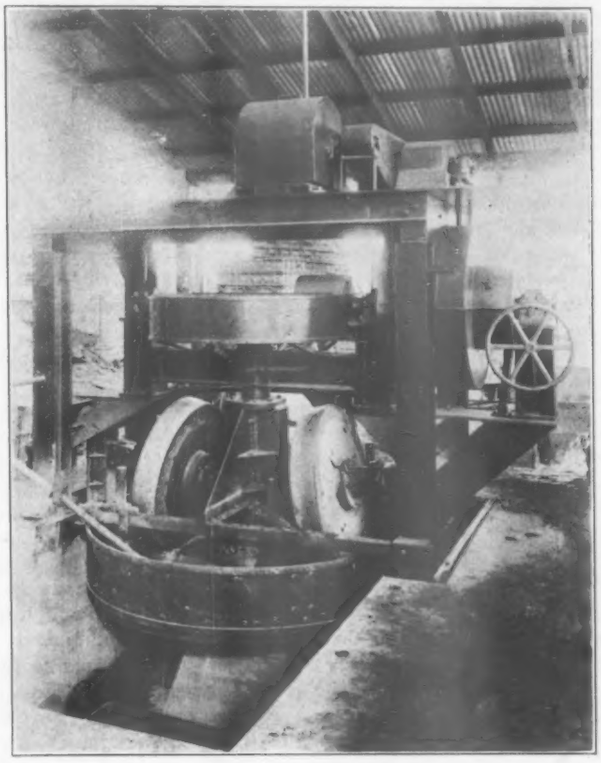


Fig. N—Foundry Sand Mill.

The interesting feature of the boring fixture in Figure E was that it was found advantageous to alter to the size of the upper hole bosses on the two large pieces (the largest is inverted in the picture). After the photo was taken these bosses were cut out with a torch and larger ones welded in. In this way they were made to do double duty and thus save an expensive duplication.

The foundry flask in Figure H is made up of several stock pieces. The outer band is a piece of ½" by 6" universal plate. The sand retaining ring is a piece of ½" round bar. The center is a piece of scrap pipe. The wedges are pieces of scrap plate. The locating lugs and trunnions are steel castings which happened to be on hand.

The evolution of some electric furnace door arches is shown in Figure I. 1 is the main plate bent to shape with some of the other pieces welded on. 2 is the top end before the final closure pieces are applied. 3 is the same view on the bottom end. 4 shows the holding brackets. These are welded to the furnace body on each side of the door arch space, after which the arch is let in and the tapered wedge driven to hold the arch in place. 5 shows the arch ready for installation. The wedges are not shown.

Necessity was the mother of invention in the case of the wheels shown in Figure L. Wheels were needed and since no pattern of the style desired was on hand pieces of 2" universal plate were used, together with some scrap tubular forgings. At the left of L1 are shown two pieces rough turned, drilled and sand blasted. To the right of the same photo are shown two pieces clamped together to be welded through six staggered holes in six places. After welding, these were carburized but not hardened by quenching. They were returned to the lathe and the hole was re-bored to admit the hub piece which was pressed and then welded in (L2). Then it was put on an arbor and the middle of the tread which had been left slightly raised was rolled with the shaft roller to close the opening left there due to carburizing heat and welding. They were then drilled and tapped, reheated and quenched, after which the bore and tread were ground. The material for a pair of these wheels can be purchased for $36.00. An equal size and similar wheel in the form of a steel casting costs $48.00 each. This job is now greatly simplified because "slabs for column bases" can be secured as thick as 9½", which eliminates the necessity of drilling the large holes and the welding through them. Only the hub is welded in. A stronger wheel of more uniform texture and hardness is obtained in this manner.

The sand mill shown in Figure N was built at less expense and more quickly than the manufacturers of such equipment could furnish one. All parts not detachable were welded. Steel castings were used for the wheel tires and iron castings for the wheels. Every part except standard units, such as motor, clutch and chain drive is welded.

FOURTH MIDWESTERN ENGINEERING AND POWER EXPOSITION

The 1929 Chicago Power Show from present indications will be unusually interesting and diversified. The exhibits promise to be varied in scope, and of such character as to contain interest for the power engineer. The Coliseum building, which will house the Fourth Exposition, and which contains over 85,000 square feet of floor space, will be completely filled with approximately 325 booths, where the visitors will be able to gain important knowledge and many ideas of the newer classes of equipment to be shown.

One of the outstanding features of the Chicago Power Show this year will be the coordinating, along practical lines, of exhibits of the same class. This will allow inspection with the least effort, and with the greatest possible saving in time. The exposition with groupings of allied products will give a better picture, allow more time in desired zones, and eliminate needless search. The commercial aspect of the Exposition is very distinctive, as opportunities will be available for not only keeping in contact with the newer developments, but will allow the visitors considerable time for personal contact where power problems can be thoroughly discussed with recognized experts in the field.

Considering the fact that there will be hundreds of manufacturers present with their best engineering talent, the visitor will be given ample means of brushing up on the recent developments in the various fields. The young engineer will find the enthusiasm and stimulation of the Chicago Power Show a wonderful asset to his future development, while the more experienced operator will find many new devices which will attract his attention, and which may be the means of considerable savings and the overcoming of many difficulties.

TELLS GEAR MAKERS ABOUT WELDING

At the semi-annual convention of the American Gear Manufacturers' Association, held in the Hotel Statler, Buffalo, N. Y., Mr. J. F. Lincoln, Vice-President of the Lincoln Electric Company, Cleveland, read a paper on "The Effects of Arc Welding on Manufacturing." Mr. Lincoln said, in part:

"Arc welding as a process has been known for at least forty years. Arc welding, however, as a manufacturing method, while it has been known for a number of years, has not been used by industry, except in a few rare cases, until the last few years. I doubt if the reason for this would be

anything like as important as to know what effect this new process is going to have in manufacturing now that it is rapidly coming to the front.

"The reason that arc welding is important is because by its use it is possible in manufacturing to apply steel where cast iron has been the usual material heretofore. Structural steel has a strength of approximately 60,000 lbs. per square inch; cast iron has a strength of but little more than one-fifth of this. Structural steel has a modulus of elasticity of 30,000,000—cast iron a modulos of elasticity of 12,000,000. In general, a factor of safety twice as great is used for cast iron as for steel.

"As an average also, the price per pound of structural steel is no more than one-third of the price of iron castings per pound, or translating this into results, if a structure is to be made whose efficiency depends upon tensile strength, the material cost if made from structural steel will be no greater than one-fifteenth of what it would be if made from cast iron, and if the factor of safety were to be taken into consideration, the ratio instead of being 15-1, would be 30-1. If the structure depends for its success on its stiffness, such as bases, bridges, etc., the ratio would be 7½-1 without the factor of safety, or 15-1 with the factor of safety. It is self-evident therefore, that the ratio between the material cost of the same structure when made from structural steel or cast iron is great enough so that a very great deal of welding could be done on it and still make a very considerable saving over a cast structure. That this saving is real can best be shown by its results when applied to the actual products previously manufactured by the use of cast iron.

"The products of an electrical company do not lend themselves by its very nature, to arc welding nearly as well as do many other industries. Yet this has been the place where the application of this process has been most fully developed.

"It is undoubtedly true that the application of welding, for instance, to the building of a lathe would be tremendously more profitable than the application to the building of a motor, yet at the present time not a single lathe, as far as I know, has ever been so constructed.

"The application of welding to the manufacture of high pressure steam boilers is another place where the saving would be enormously greater than in the application to electrical machinery, yet in this case, as far as I know, there has never been a single boiler so constructed.

"Arc welding can be applied to the manufacture of a ship's hull with enormously greater savings than would be possible in the places where it has now generally been applied, yet as far as I know, no large ship has ever been so constructed, although a number of small ones have been.

"The reason these applications have not been made is not hard to find. There are many lesser reasons but the most important ones are three:

First—Mental Inertia.

Second—Fear of the change of looks.

Third—Standards made by committees or technical bodies who are not fully informed.

"Mental inertia is one of those things for which there is no universal cure except the grave and I think it is safe to say that many industries in which arc welding must be eventually applied largely, will never be applied during the life of the present ruling generation.

"I imagine we are in the same situation regarding this matter as we are regarding the airplane. It is doubtful if the present generation who are the heads of business will themselves become airplane pilots. There is very little doubt however, that their sons and grandsons will pilot an airplane with the same ease with which their forebears are now piloting automobiles, and yet most of us can remember the time when as children we saw the automobile pass our door and had our fond parents tell us that such things are either of the devil or at least extremely dangerous and to never venture near them. I think, therefore, the future of welding as applied to redesign of machinery is going to be largely dependent upon the rising generation rather than on the generation now in control.

"In connection with the matter of looks, it is rather interesting to note the reaction of many people when redesign in the light of arc welding is suggested—they immediately are shocked by the change in appearance. They are used to the flowing curves, the rounded corners, and the marked draft on all castings. They also feel that since castings are brittle and will break if bent slightly that cast iron is therefore rigid, which is exactly the opposite of the facts. As a matter of fact, the reason that castings are made with the sloping faces, the rounded corners, and the elimination of sharp lines, is because it is impossible to draw a pattern of any other shape successfully from the sand, and the appearance which we are now used to is the result not of artistic temperment on the part of the designer but sad necessity on the part of the foundryman. We generally think that what we are used to is beautiful and what we are not accustomed to, as being ugly. All of us remember the styles of the gay 'nineties' which at that time were supposed to be the acme of perfection. They would certainly provoke a long and loud laugh if they should appear in this hall at this time. I hesitate to say what the next generation will think of present day styles if the change is as marked in the next thirty years as it has been in the last. It will not be well to even trust our imagination.

The rules of technical societies and committees also have been a very great hindrance to progress in many lines. It is not my intention at all to depreciate the great service which these standardization bodies have been, but it is a good deal like food—the proper amount is necessary and extremely important—twice this amount probably means an early death. It is rather difficult to see at the present time the sense in the rules which are now largely followed, that a locomotive boiler may be welded practically without question, but if this same boiler is taken off the track and put on brick foundation, run at 16 lb. pressure instead of 200 lb. pressure, it then becomes a stationary boiler and comes under the rules of the State Boiler Inspector. Any man operating such a welded boiler under those conditions will be put in jail. It is rather difficult to see why that boiler can run over the tracks at sixty miles an hour safely with 200 lb. pressure, while it cannot operate stationary at 16 pound pressure and still be safe.

"It is rather difficult, too, to understand the point of view which rules that a boiler must be riveted but the superheater into which the steam goes after being generated must be welded, and that the piping from the superheater to the turbine must be welded.

"It is rather difficult to understand why a stationary boiler cannot be welded and yet a cracking still which operates at a pressure several times as great and at a temperature several times as high, should in general always be welded.

"It is rather difficult to understand why a tank car must be riveted and under no conditions can a tank car which is welded be operated over the railroad lines, yet the tank into which the tank car is emptied must be welded.

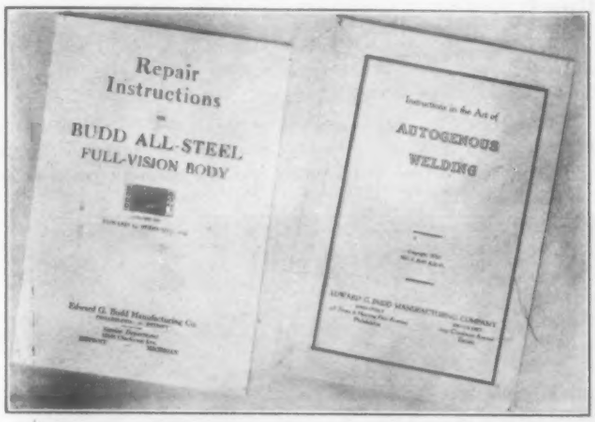
"There is, undoubtedly, a perfectly satisfactory reason in the minds of those making such rules—it is rather hard, however, for the man outside of the committee to fully understand the reason."

BUDD ISSUES WELDING INSTRUCTIONS TO AUTO BODY SERVICE STATIONS

An item in the *International Acetylene Association Forum* for November describes the policy of the Edward G. Budd Manufacturing Co., Philadelphia, well-known makers of welded

all-steel automobile bodies, in establishing repair service stations for auto bodies throughout the country, advocating repair of damaged body parts instead of replacements.

Joseph W. Meadowcroft, assistant works manager of the company, has been instrumental in the preparation of pamphlets on repairs of Budd all-steel bodies, generally applicable in lesser degree to the parts of other steel bodies, and has also had an instruction book on autogenous welding



How the Budd Company Promotes Use of Good Welding Methods.

printed in an edition of 25,000 copies for distributing to service stations.

Although the Budd company employs electric spot and flash resistance welding largely in body manufacture as well as the oxyacetylene process it recognizes the advantages of gas welding for service station repair work because of the simplicity of the apparatus, low cost and universal application to all welding.

The repair instruction booklets are illustrated showing how wet asbestos is applied adjacent to the weld, and the sand bag, dolly block, bumping hammer, mallet, body spoon, lifter and other tools employed in body repair.

The instruction book on autogenous welding is divided into four lessons, Nos. 1 and 2 being on apparatus and operations, and 3 and 4 on sheet metal welding.

The instructions concisely describe the apparatus, operation, precautions to be taken to prevent flashbacks, and what to do if one develops. The lessons are in question and answer form throughout.

WELDING MAKES SUPERIOR FITTINGS FOR CORRUGATED IRON PIPE

Like everything else in this fast-moving age, drainage construction is being speeded up. And in this, as in other work, welding plays no unimportant part.

Welded Tees Provide Drainage Inlets for Railroad Yard.

The Armco Culvert Manufacturers Association, Middletown, Ohio, whose members make corrugated iron pipe for culverts, storm sewers, subdrains, and other drainage purposes, have simplified and expedited installations of these products by the use of standard welded fittings. Consisting of elbows, bends, tees, wyes, crosses, catch basins, and reducers, these fittings are made in any combination of sizes to fit standard Armco corrugated pipe, to which they are readily attached with corrugated iron connecting bands.

The fittings are made of the same material as the corrugated pipe itself—Armco ingot iron. They may be corrugated throughout their length like the pipe or merely on the ends, as shown, for attaching the corrugated connecting bands. In the latter case, heavier gauge metal is used. Welding is done by hand, Armco ingot iron filler rods being used in the process. After welding, the entire fitting is bituminous coated.

Besides presenting a workmanlike appearance, the welded fittings are said to be much stronger than the riveted fittings which they have largely supplanted. Out of many specimens of fittings tested to failure in a testing machine, only one instance is known of even a slight break in a weld. As the machine tests were much more severe than could be imposed

Welded Fittings Used to Simplify and Speed Up Drainage Construction.

by loads encountered in actual service, this is taken as conclusive proof that the welded fittings have ample strength for any drainage purpose.

Typical applications of Armco welded fittings to underground construction requiring connections between intersecting lines of pipe or deviations from a straight line, comprise drainage for: airports, athletic fields, city storm sewers, em-

Standard Armco Catchbasin.

bankment erosion protection, playgrounds, railroad yards, stream crossings for low-lying roads, street and road intersections.

Acetylene in the St. Francis Dam Disaster*

Welding, Cutting and Lighting Played Important Parts in the Heroic Efforts of Emergency Crews to Minimize Losses and Speed Up Reconstruction

By J. B. Ross†

AT twelve-fifty on the morning of March thirteenth, with a dull roar and numerous electrical flashes, twelve billion gallons of water came rushing down San Francisquito Canyon on a destructive rampage through the Santa Clara River Valley to the ocean. This major catastrophe occurred after the breaking of the St. Francis Dam, a part of the City of Los Angeles' aqueduct system. The short circuiting of Power House Number Two, near the dam, caused the electric flashes.

Gas, electric, water, telephone, telegraph, railroad and highway facilities were swept away by the tremendous force of onrushing waters.

When Mr. Citizen read his paper the next day and the front page blazoned forth with the news that five hundred lives had been lost in addition to millions of dollars of property, it was probably discounted fifty to seventy per cent. Unfortunately as later figures confirmed, the reported number of dead and missing was close and the property damage far exceeded first reports.

The news that filtered through told of heroic deeds of rescue and of the diligent search that was being made for the missing. We were as a whole in deep sympathy and eagerly scanned the papers for names that to many brought ill-tidings.

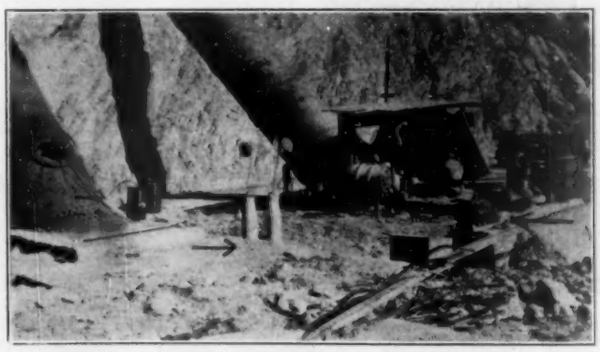
There was, however, another army of workers doing work in the flooded area who are deserving of recognition. I speak of that silent group of which so little is heard, namely the repair crews of the public utility companies and the crews of the Water Department of the City of Los Angeles. These men moved into the devastated area to repair and rebuild power lines and pipe lines that carried to the million and a half people of Los Angeles gas, fuel and water for their daily consumption.

It is due to this highly organized army and the ammunition that they had, that no serious consequences followed in providing water and fuel to the local country through rapid repair of the aqueduct system and the pipe lines carrying natural gas from the oil fields at Taft and Ventura to the city of Los Angeles.

Repairing 12-inch Gas Line After Waters Had Subsided.

Among the first pieces of equipment to be moved in were cutting and welding outfits with the familiar cylinders of oxygen and acetylene. Twisted and cumbersome masses of steel, formerly bridges and other steel structures, had to be moved or set aside that the work of the rescue could go on unimpeded.

Then came the survey and construction crews to plot and rebuild pipe lines that had been completely washed out. It was hardly to be expected that pipe lines would survive intact



Acetylene Flood Lights for Night Work and Small Tanks of Acetylene for Making Electrical Connections.

*Paper read at the Annual Convention of the International Acetylene Association, Chicago, November 14, 1928.

†Oxweld Acetylene Co., Los Angeles, Calif.

the terrific force of this flood and with one exception all lines were completely carried out when hit by the flood. This was indeed a major piece of reconstruction. Eleven pipe lines ranging from two to twelve inches in diameter were completely washed out where they crossed the river bed. These pipe lines were carrying oil and natural gas.

The rebuilding and welding of these lines with the oxy-

Twelve-Inch Gas Main from Ventura to Los Angeles. Welding Prevented Rupture at the Joints.

acetylene process was commenced two days after the break and immediately on delivery of pipe. Experienced crews of pipe welders were drafted for this work and rapid reconstruction of all lines were the results.

It will be of interest to note that when pipe lines were to be built nothing was considered but the oxy-aceylene welded

Southern Counties Gas Co. Line. Rupture Occured in the Pipe, Well Away from the Weld.

joint. The one screw joint pipe line that crossed the river was completely washed away and very little was ever recovered. We were particularly interested in studying the broken pipe. Evolution seemed to be going on in the added strength of welded pipe joints. It was observed that pipe lines welded the past few years were much stronger and the pipe was just as much likely to be found broken in middle of pipe as at joint. Many pieces were found that had broken off in this manner. This was particularly so of the last pipe line to be completed before the dam broke.

While this activity was going on, several miles away was the scene of a more dramatic reconstruction, the repair of a water tunnel that had broken through the mountain side. This was the connecting link in the Los Angeles aqueduct system. With the breaking of the dam, such tremendous pressure was exerted through this bore that the water broke through in several places and followed the course of the main body of water from the broken dam.

Water was headed off at the mouth of tunnel and men entered to clean out and reconstruct. Here again acetylene was to play an important part. Auto lighting cylinders containing acetylene were drafted and placed in tunnel with connecting hose and burner to provide light for the crews working. At the length of the tunnel is almost three miles and no electric current available, acetylene gas was able to hasten the repair of an important link in the great aqueduct system.

The portable acetylene generator floodlight also assisted in the repair of this tunnel. Where the water had crowded

Welding Temporary Line into Sections on the Dry Ground Before Pulling Out Across the Wash.

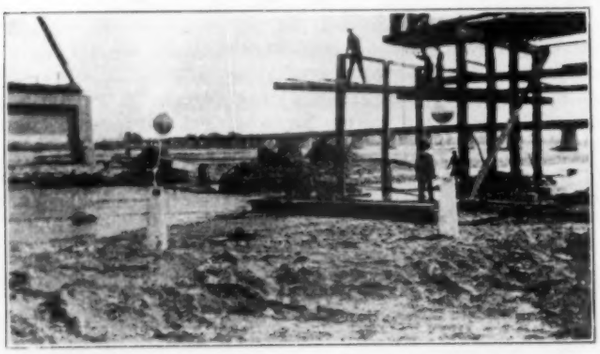
through the hillside the tunnel had to be entirely rebuilt; this involved day and night work. This portable light, enabled the reconstruction gangs to have a major portion of the repair completed when wire connections had been installed and electric light made available.

The various bridges that crossed the Santa Clara River all served as a connecting link between Los Angeles and the northern part of the state. With one exception, these bridges were demolished or damanged to such an extent that traffic was checked. The Montalvo bridge on the state highway had the west end washed out. As it was imperative that this bridge be repaired, attention was directed here first and contractors were on the job shortly after the flood. The acetylene floodlights were also used on this job and hastened the reopening.

As an aftermath to the disaster much of the possible salvage material had been assembled at one point and one could watch with much interest the busy work of several oxy-acetylene cutting outfits. One job that particularly attracted attention was the salvaging of the inner shaft of a power turbine. After all appendages had been removed a piece of steel remained, about fifty-four inches long by twenty-two inches in diameter. An eight-inch shaft running through the center of this and frozen tight was the desirable objective. To secure this piece undamaged a lance blowpipe was used to

cut a hole the length of the block and just over the inner core. The object of this operation was to secure passage for the slag when longitudinal cut was made directly over cut pierced by lance. This operation was repeated on the opposite side and when completed, wedges were driven in and the inner shaft retrieved.

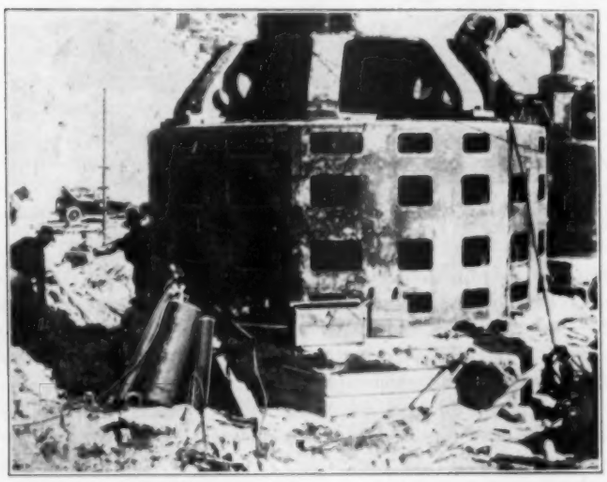
It might be of interest to know that a ¼-inch pipe connected to hose leading from oxygen cylinder was the lance used. After cut was started and properly heated by the



Night Work on Bridge Reconstruction Made Possible by Use of Acetylene Flarelights.

cutting blowpipe the ¼-inch pipe was inserted with oxygen pressure ranging from one hundred and twenty-five to three hundred pounds to the square inch. As the cut progressed pipe was naturally consumed and when operation was completed ninety-five feet of ¼-inch pipe had been used.

From San Francisquito Dam to the ocean, a distance of 42



Dismantling Electric Generators with Cutting Torch. The Rest of this Power Plant was Demolished by the Rush of the Water.

miles, the great Santa Clara River Valley was a bleak ruin, and to the north a great many towns and municipalities were without electricity or gas because of the broken power lines and pipe lines. That the worst of these conditions were removed within a few days can be attributed in very great measure to acetylene and allied products. Day and night, tank acetylene and oxygen repaired gas and oil lines, soldered power and communication lines together, and acetylene flood lights furnished light for the night work.

When we try to think of some other product that might have equally facilitated the restoration of light, heat and communication to this stricken area, and fail to find it, we of the Acetylene Industry may well be proud of our part in the recovery from this great disaster.

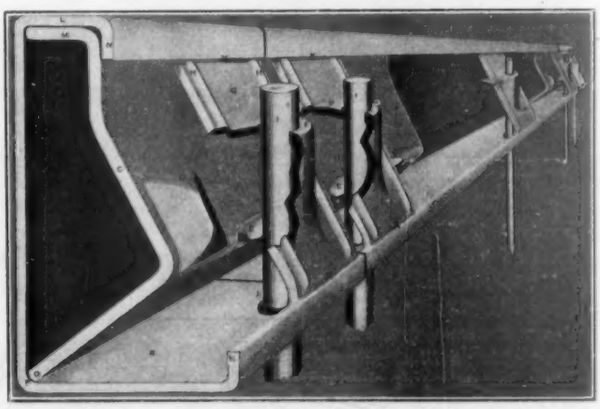
BAIN-BEAIRD CO. BECOMES BEAIRD CORPORATION

The Bain-Beaird Company, Inc., of Shreveport, Louisiana, announces a change in corporate name to The Beaird Corporation, and a removal of their offices from Texas and Reynolds Streets to the general plant on Atkins Avenue at Cedar Grove road. Here a modern new office building, with a new machine shop, and enlarged oxygen plant, where new machinery is being installed to double the capacity of this department of their business, with increased warehouse room and better trackage facilities, will permit more centralized control of all activities and allow more complete service to all patrons.

There are several distinct departments to the business of The Beaird Corporation; oxygen and acetylene gas manufacturing, welding supplies, welding and cutting apparatus, carbide, machine shop, tank car repairing and structural steel work. The business as a whole has shown remarkable growth in recent years as evidenced by the necessity for a large and more up-to-date plant.

WELDED STEEL CONCRETE ROAD FORMS GIVE GOOD SERVICE

The Heltzel Steel Form and Iron Company of Warren, Ohio is manufacturing a concrete road form of very simple design with quarter inch hot pressed steel stake pockets electrically welded to the rails. A lock joint 16 inches long when driven in place wedges tightly between the stakes and rails. This makes them self aligning with a positive locking device. These forms have been in use in the road construction work of several states, and apparently have proved very satisfactory. They are



Welds at "X" Add Strength and Rigidity Where It Is Needed.

just another of the many indications of the value of welding in the field of production.

MOVIE SHOWS BUILDING OF ARC WELDED STEEL STRUCTURE

The complete story of the application of electric arc welding in the fabrication and erection of the structural steel for the recently completed Upper Carnegie Building is portrayed in a motion picture produced by The Lincoln Electric Company, Cleveland, Ohio. The four-story structure, whose construction has been filmed, was designed exclusively for arc welding and contains many new and unique features of construction which attracted marked attention from the many architects and engineers who inspected the building during erection.

The motion picture opens with the fabricating of the steel in the fabricating shop and continues as the work progresses to the completion of the building, thus offering an intimate study of the building design and methods of fabrication and erection.

The movie is contained in three reels of 16 mm. film and can be conveniently shown to practically any size group in an office, club or class room. It is offered gratis for showing upon application to The Lincoln Electric Company.

Arc Welding Brass and Bronze

Frequent Demand for Repairs in Place Have Led to Development of Technique for Using Carbon Arc With Bronze Filler Rod in Naval Work

By R. H. Davis*

[EXPLANATORY NOTE: *The welding of brass and bronze by the oxy-acetylene process is so well known that a description of it or an enumeration of its applications can scarcely have any of the interest of novelty. On work which can be readily dismantled and sent to the shop and which can stand the extensive heat it is the preferred process. The composition of the added metal can be held more nearly like the original and a weld free from pinholes may be produced more easily by the oxy-acetylene than by the electric process. However, the welding of brass and bronze by the arc has reached to quite an extent in the United States Navy Yard, Puget Sound, and a description of some of the work accomplished and methods used may prove of interest.*—THE AUTHOR.]

AS IS well known, the arc welding of steel is a well-established and widely used process in both the construction and repair of vessels of the United States Navy. Considerable has been written and published in the pages of *The Welding Engineer* and elsewhere concerning this phase of the work but, so far as known to the writer, comparatively little has been said concerning the extent to which the arc process has been applied in welding brass and bronze. Owing to constant exposure to salt water or to salt-laden air, steel and iron corrode rapidly and consequently brass and bronze are freely used by the Navy in such parts as hull fittings, hinges, hasps, portlight fittings, gun parts, condensers, piping and around pumps, engines and machinery of all kinds wherever such metal is suitable and corrosion is threatened. But wear, breakage and obsolescence take their toll on brass and bronze the same as on any other metal and so the Navy Yard welders are very frequently faced with the question, "Can you fix it?" It is often asked of the arc welders with the added provision, "Can you fix it right where it is?"

"You know what it would cost to tear that out and take it to the shop and bring it back here and install it again. And, for Gosh sakes, be careful of your heat! If that is cracked any more it will be ruined, and then we'll both be in for it!"

Certain jobs have been done so often that there is no question of their feasability; procedure has been reduced to an established practice and everyone knows what to expect. Among such jobs are:

1. Repairing breaks and holes and building up thin spots in ⅛-inch thick brass used for lining trays and chutes.
2. Extensive welding of holes, seams and butts when repairs or alterations are made to that part of the pilot house or navigating bridge which is near the magnetic compass and is built entirely of brass.
3. Tacking and welding brass flanges on brass pipe used for drainage lines.
4. Welding hooks and rings to life-rail stanchions on destroyers. (It might be remarked in passing that these welds are immediately tested by pulling with turnbuckles and hammering.)
5. Welding up holes in brass flanges.
6. Building up small bosses and worn places on parts for machining.

But it is the unusual jobs, jobs, the exact duplicate of which the welder never saw before and will never see again, that furnish the thrills and the (occasional) gray hairs. Among such that the writer recalls are:

1. Welding a rolled brass lip to a large bronze casting *in place*, vertical, downhand and overhead welding required.
2. Welding copper tubing to brass pipe union. Four of these welds were made and have been known to have had pressures up to 2,200 pounds per square inch, hydraulic, on them without leaks or sign of failure.
3. Welding rolled brass brackets to cast brass deck beams, welding straight overhead.
4. Welding brass to steel in many cases. A large number of similar jobs might be recalled from the history of the last ten years but the samples enumerated above will serve to show the general nature of what has been attempted and performed. An alert and intelligent shipfitter, machinist, pipefitter or other mechanic will often discover where he can save days of time and dollars in money by welding, either to repair a broken or worn out part or to cut and weld an old part or fitting to serve new uses. Next comes consultations and the securing of proper authority to go ahead. Then it is up to the welder. Mention of a few of the problems most generally encountered and methods of solving them may be of interest.

Proper ventilation is always a major problem, especially in closed compartments, as the dense white smoke produced by arc-welding brass will cause a severe case of "chills and fever," or "brass-founder's ague," in any person who breathes much of it. Other people working in the vicinity must be protected as well as the welder. Ventilation is usually secured by the use of large forced-draught blowers. In some cases the welder is supplied with a helmet having a stream of fresh air entering at the top.

After the question as to whether the job can be done at all or not on account of ventilation is disposed of, comes the question, "Will it weld?" for cast brass is like cast iron, no two pieces ever just alike, and compositions vary from "Composition G," or gun bronze which is rich in copper and tin to "Composition S," which the welders say stands for "scrap." The first welds beautifully while the latter occasionally simply cannot be welded by the arc process due to the high percentage of zinc. In welding brass the zinc has a marked tendancy to burn out. If the piece is high in zinc the intense heat of the arc causes it to burn up rather than to melt and proper fusion cannot be secured. An experienced welder can often tell simply by looking at the broken section whether he can weld it or not.

After fusion comes the problem of expansion and contraction. Brass is a better conductor of heat than steel or iron. Consequently a greater quantity of heat must be applied to a given spot before a welding temperature can be built up at the surface. And, for a given temperature rise, brass will expand something like twice as much as cast iron. This means that expansion and contraction must be considered on most brass jobs, even in arc welding. Where contraction cannot be circumvented or overcome by ordinary means it is prevented by keeping the job cold, welding a little bit at a time and peening the weld. Each small section is hammered during the time it is cooling off but some experience and judgment are required in order to spread the weld to its full depth and still not hammer it at such a time or in such a way as to cause it to crack. The tool usually used is a light air hammer with a fuller or a round pointed bobbing tool. It is well, if possible, to have a helper back the weld with a twelve-pound hammer or similar tool while the hammering is going on. Such jobs as welding a flat sheet between the sides

*U. S. Navy Yard, Puget Sound, Bremerton, Wash.

of a heavy rigid frame have been accomplished in this way.

The welding method used almost exclusively is the carbon arc with phosphor bronze filler rod ⅜-inch carbon, 3/32-inch rod. The polarity is the same as in steel welding, positive on the work, negative to the hand. A good rule for a trial setting of the amperage is, "Take the same heat you would for 3/32-inch steel rod on a steel job of the same size and thickness of material, then raise it about 10 or 15 per cent." More heat than this may often be used. Most of the welders here use all the heat they can handle on brass, as the more quickly fusion is effected the less chance there is for burning the zinc out. Many a novice fails miserably on brass by using too low a heat. The way to do brass is to use plenty of heat and add filler rod at just the right instant when the fusion point has been reached and before the job begins to burn up.

When construction is not a controlling factor and the welder can use the heat as he wants it, it is found that copper and the copper-base alloys, brass, bronze, etc., usually weld best when the work near the weld is at a low red heat. When the work gets to this temperature a little more heat will run it by causing it to run or to slough away. Therefore, the heat input must be reduced either by intermittent welding or by cutting down the amperage. The latter method is preferable, as then welding can be kept going steadily and still a nice heat balance maintained in the work. But when a welder is four decks down plus half a ship-length and across a busy pier away from his machine it is hardly practicable to run out and change the current setting and get back before the job gets cold. And, let me add, the best machine to be had is none too good for welding brass. If ever a man wants something and wants it now it is an arc welder trying to weld brass with a machine too small for the work. Even a welder who has spent years around the railroad shops and the navy cannot supply language with heat enough in it to save the situation for a poor little run of a machine two sizes too small for the job. And so the wise welder sees to it that he has a sufficient supply of "amps." available before he starts his heat.

In an effort to determine the probable strength of carbon-arc welds on brass some samples of naval rolled brass ¼ inch thick were welded and pulled. All broke in the welds. Two samples made with phosphor bronze showed an ultimate tensile strength of 31,000 pounds per square inch. One sample made with Tobin bronze for experiment showed 36,000 pounds per square inch. In many cases phosphor bronze welds are proving better than the cast brass they are attached to, taking chunks out of the casting on either side when broken or standing strains which break the castings in other places.

In conclusion, a word of warning to all welders: DON'T BREATHE THE SMOKE FROM BRASS WELDING! It won't kill you, but it will make you heap sick. If you can't do the job in the open or with proper ventilation, don't do it, that's all.

PURDUE UNIVERSITY HOLDS FOURTH ANNUAL CONFERENCE ON WELDING

The Engineering Extension Department of Purdue University held its fourth annual conference on welding at Lafayette, Indiana, on December 12, 13 and 14, 1928. It was held under the direction of the Engineering Extension Department and the Department of Practical Mechanics, with the School of Civil Engineering and the manufacturers of welding equipment co-operating. A large group of men interested in the latest developments and possibilities of welding in its various forms were in attendance. Both electric and oxy-acetylene welding were covered by the program. Manufacturers of welding equipment from both fields had equipment, lecturers, and demonstrators in attendance. The program was as follows:

WEDNESDAY, DECEMBER 12th

10:00-12:00 m. Registration and Inspection Trips. Exhibits and Demonstrations.

Afternoon

1:00 p. m. Exhibits and Demonstrations.

1:30 p. m. Address of Welcome—A. A. Potter, Dean of Engineering, Purdue University.

Announcements—W. A. Knapp, Professor in Charge, Engineering Extension Department.

Education in the Welding Field—J. D. Hoffman, Head, Department of Practical Mechanics.

Problems in Welding Alloys—E. D. Flinterman, Michigan Steel Castings Company, Detroit, Mich.

Effect of Tip Sizes and Pressure on Economy of Cutting—J. J. Crowe and George M. Deming, Air Reduction Sales Company, New York.

THURSDAY, DECEMBER 13th

Forenoon

8:00 a. m. Exhibits and Demonstrations.

8:30 a. m. Welded Pipes in Buildings; Motion Picture Film; Gas Products Association—Discussion lead by H. S. Card, Editor, Welding Engineer, Chicago.

Welding Steel Bridges and Buildings—F. B. McKibben, Consulting Engineer, General Electric Company, Schenectady, New York.

Developments in Oxy-acetylene Welding and Cutting—J. W. Haygood, Linde Air Products Company, New York.

Afternoon

1:00 p. m. Exhibits and Demonstrations.

1:30 p. m. Can Welded Frames Take the Place of Castings—Robert Notvest, Lincoln Electric Company (Indianapolis), Cleveland, Ohio.

Welding Pressure Vessels—T. W. Greene, Linde Air Products Company, New York.

Mechanical Welding—J. L. Anderson, Air Reduction Sales Company, New York.

Developments in Electric Welding (a) Automatic Equipment; (b) Atomic Hydrogen Arc—W. M. B. Brady, General Electric Co. (Chicago), Schenectady, New York.

Evening

In Lecture Room—Civil Engineering Building. Meeting with Student Branch A. S. C. E.

7:30 p. m. Use of Welding in Structural Work (Illustrated Lecture)—F. B. McKibben, Consulting Engineer.

FRIDAY, DECEMBER 14th

Forenoon

8:00 a. m. Exhibits and Demonstrations.

9:00 a. m. Effect of Welding on the Metal—H. L. Maxwell, Associate Professor, School of Chemical Engineering.

Applications of Welding in Erection of Upper Carnegie Building.

Motion Picture Film—Lincoln Electric Company.

Changes in Manufacturing Methods Made Possible by Welding—A. M. Candy, Westinghouse Manufacturing Company, Pittsburgh, Pennsylvania.

Application of Resistance, Spot and Butt Welding—B. T. Mottinger, Federal Machine and Welding Company, Warren, Ohio.

Afternoon

1:00 p. m. Special Demonstrations—Cutting Cast Iron, Bronze Welding, Stelliting, Oxygen Lance, Electric Welding, Mechanical Pipe Welding with Gas, Thermit Pipe Weld, Aluminum Welding, Welding Cast Iron.

Other Demonstrations as Announced.

Making the Oil Men Like It

The Story of Hard Facing Has Been One of Steady Progress to a Point Where Oil Drillers Look on It as a Necessity

By C. L. McCorkindale

PREVIOUS to the latter part of 1922, skepticism and intolerance greeted the man who introduced a bit to the oil industry that was anything but oil or water tempered.

It was during this period of skepticism that the Stoody brothers, W. F. and S. M. (now president and vice-president of the company bearing their name), were conducting experiments on the hard facing of oil field drilling bits in a little welding shop located at Whittier, Calif. Their aim was to develop a hard facing that would permit the rotary drill bit to pass through the hardest formations. Before this, the cable tool (or percussion methods) had always been used to drill through formations harder than the metal of the bit.

W. F. Stoody S. M. Stoody
The Stoody Brothers Have Made an Industry of an Idea.

First they used plain high carbon rod for building up the bits to gage. These they sent out without tempering or chilling in order to retain the toughness of the facing metal. This method was not so successful, so a high carbon rod with a tungsten, chromium and carbon coating was introduced. This rod was applied in beads to the cutting edges of the bit and gave alternating hard and soft sections to the finished product. As this, like the first, was not entirely approvable, a third rod was made by placing alloys inside a sheath and then rolling the sheath into a tube, which, unlike the foregoing rods, ran smoothly and gave unusual performance in comparison to the oil and water tempered bits. And so a successful hard facing metal, Stoody Self-Hardening Alloy Steel Rod, was presented to the drilling departments of the petroleum industry.

From this introduction until Stoodite was made by the Stoody Company in 1923, Stoody Self-Hardening Alloy Steel Rod served the drillers by lowering the operating costs. With the advent of this new metal the runs became still more phenomenal and further increased the percentage of efficiency of the bits. Its application was at once extended from the fishtails to the patent bits, such as discs, etc., until its use covered the entire scope of the oil industry.

The first man to run these bits was A. J. Graham of the B. G. T. Oil Company of Santa Fe Springs. Graham used the first rod, and later the Stoodite rod and followed directly in the development steps of the Stoody brothers. Following Graham was Al Johnson of the Federal Drilling Company at Santa Fe Springs. These men, like Morris and Drake, were pioneers. They took the early chances and made the premier trials of a process which was destined to change the entire drilling process of the oil industry. It is to them that W. F. Stoody is indebted for a chance to test the brain children of himself and his brother; and it is to them that the oil fraternity owes great appreciation for being considerate enough to give the inventive genius of the Stoody brothers a chance to function properly.

But still the oil operators were not satisfied with just a superhard facing—they wanted something still harder, something with a diamond-like hardness that would replace the use of the extremely expensive black diamonds that were often used to penetrate extremely hard formations. This demand kept increasing until quite a few men were attempting to introduce a metal fitted for such a purpose as this. In March, 1927, a metal known by the trade name of Borium was presented to the oil fraternity by the same men who developed the first hard facings. At once this new diamond substitute was eagerly tested and tried under most every conceivable condition and proved to be another revolutionary process for the drilling fraternity of the oil industry. Within nine months after introduction it was being used extensively and the runs it made eclipsed anything that the drillers expected.

Hard Facing A Fish Tail Bit.

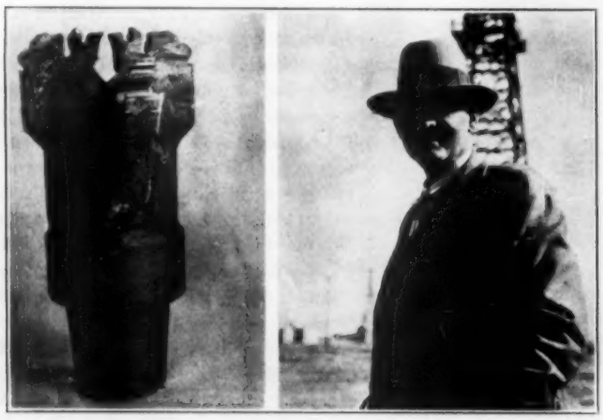
Told in this brief manner, it all sounds simple and easy, but the history of hard facing—(the process of placing a metal with a high degree of hardness on the cutting or rotating edge of a drilling tool, so that the softer, or base metal, wears away from the harder metal and gives continuous bottom clearance to the bit), is a history filled with nerve-racking tests, made under trying and unsympathetic conditions. Its entire scope is dramatic and singularly impressive—more so than most of the stages of the development of the tools of drilling.

Backing the creative work of these pioneers, was the constant use of the arc and the torch. In the case of the first rods it was mostly the arc, as the cohesiveness of Stoodite is greater when applied in this manner. In the case of Borium, the torch was, and is, always used, since the electric arc will oxidize it. In this application the Borium is set on

with a high carbon rod, and surfaced with Stoodite to hold it in place. These same processes are necessary in all the fields of hard facing. In fact, it can truly be said that welding is the backbone of hard facing.

When Borium was first discovered, small pieces of it were brazed to the edges of the bit. Some of these bits made remarkable runs; others only a few feet, due to the circulation cutting away the soft bronze and allowing the Borium to fall off the bit. As soon as this error was discovered the method of application explained in the foregoing paragraph was adopted, because the Stoodite does not wear away and allow the Borium to separate from the cutting edges.

Following directly in the development of hard facing, the Stoody Company has expanded from a mere "welding shop



At Left, a Four Way Borium Bit after Run of 870 Feet Through Formation That Was 40% Sand. Notice How Softer Metal Has Worn Away and Left Borium Mounting Standing Alone. At Right, A. J. Graham, Who Used a Hard Faced Bit in the Oil Fields in 1922.

on wheels" in the early part of 1921 to a company that is known all over the world as manufacturers of welding rods, alloy steels, and welding equipment. The expansion of this company has been constantly stimulated by the genius of the Stoody brothers, until at the present this concern operates from a dozen distributing centers in the United States, and has representatives in ten foreign countries. Their plant equipment is as modern as any in this country. From the first this company has been intensely progressive and have catered to young blood and modern ideas. As an indication of this, the organization now operates an airport in connection with its home plant, and owns a Fokker Universal monoplane which it uses for advertising and business purposes. In the future this airport will be one of the centers of aviation in Southern California, equipped for night landings, schooling and general aeronautics.

REMARKS ON WELDING AS A BUSINESS

It is always interesting for those connected with welding to exchange ideas and listen to the experiences of others in the same business. In writing of welding as a business, Mr. Charles Haeusser of Albany, New York, says that he does not conclude his services to his customers with just the actual work, but that he goes further, and is always willing to answer questions, give advice when wanted, and explain the causes and remedies for many of the obscure breaks which come into the shop. For example, a customer may ask the cause for a broken engine lug. The answer may simply be that the frame is rickety because of loose rivets. Examples of other questions answered are as follows:

Question, "What broke this bearing?"

Answer, "A bent shaft, be sure and straighten it before replacing."

Question, "What broke this gear?"

Answer, "A weak bearing support allowed the teeth to spring out of mech and rip."

Question, "What wears out these bearings?"

Answer, "The flywheel is out of balance."

Question, "What cracks these spokes?"

Answer, "They are straight spokes with no chance for shrinkage or expansion."

Explaining such problems is an invaluable service which every welder can render to his customers, and is one which will bring returns in the form of a steady and increasing business.

Continuing with his remarks, Mr. Haeusser goes on to suggest possible reasons for the lack of prosperity in many welding shops. He says that in the first place many men start in with the idea that welding is an easy instead of a highly specialized trade. They turn out work which does not hold, so that naturally their patrons come but once. Then again, even if they are good welders, they may be located in such a place that their available supply of prospects is limited, and for that reason may have to quit because of the lack of business to keep them going. But the main cause of failure in his opinion, is the lack of safe and healthy working conditions. He emphasizes the use of a ventilating fan in his shop. When the fumes are very bad, the use of a gas mask is recommended. There are many other suggestions in regard to maintaining safe shop conditions which most welders are acquainted with, but which unfortunately they do not put into practice. Putting such rules into practice appears to be a waste of time to quite a number of people, but if they would just consider that the injury or sickness resulting from the disregard of these rules is not only a waste of time, but an expense, they would use more care in following them.

HIGH PRESSURE STEAM LINE WELDED AND ANNEALED IN THE TRENCH

A pipe line job containing several unique features has recently been successfully completed in the city of Philadelphia. As related by Mr. Henry Harrison in the October issue of The Compressed Air Magazine, the line is a high pressure steam main three quarters of a mile long laid down under one of the busiest streets of the city. Pipe 18 inches in diameter with walls ½ inch thick was used. The actual work was performed by the Northwestern Pipe and Construction Company using oxy-acetylene equipment. The trench was from 12 to 18 feet deep, such depth being necessary in order to pass under the numerous other underground lines found in the district in which they were working. As one may surmise the actual job of doing the welding was very difficult, indeed. It was generally necessary to put in timbering at the places where the welding was being done in order to prevent caveins. The operators had to work in a variety of uncomfortable positions in making the welds but their work as a whole was very satisfactory.

After each weld was completed the metal was annealed for a distance of 6 inches on each side. This was done by means of a special furnace built by the American District Steam Company following a number of months of extensive experimenting. The heat was obtained from an atomizing oil burner manufactured by H. H. Kress of Philadelphia, and was operated by compressed air from an Ingersoll-Rand Compressor. After the heat had been applied the furnace was left in place long enough to permit the metal to cool properly and thus avoid undue strains. The cost of annealing each joint amounted to less than $2.50.

The final operation consisted of placing a collar 12 inches long by ⅜ inch thick over each seam and welding it in position. Then with the expansion joints at each end and the heavy asbestos coating they have a power line from which they will undoubtedly get long and continued good service.

Arc Welding Boiler Tubes

Methods Which Have Been Developed to Eliminate Some of the Common Troubles Encountered in Locomotive and Stationary Boiler Maintenance

By G. H. Clark*

IT HAS always been standard practice where flues were to be welded, to apply the flues as if they were not to be welded and weld around the bead.

This means that the flues must be swedged, copper ferrules put in the flue holes in the sheet and rolled lightly, then the flues applied, rolled tight, belled over for beading, prossered with a sectional expander and beaded, then welded around the bead.

This would not be so bad if after doing all of this work the job was 100 per cent good, but this is not the case.

One of the redeeming features of a boiler has always been that it would leak when there was anything wrong. With flues electric welded in the sheet in the old manner, the welding did

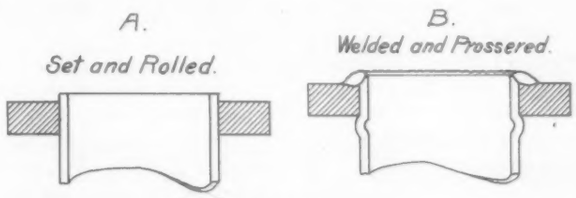


Fig. 1.

not prevent the thing occurring that used to make them leak when they were not welded, but made it impossible for them to leak, at least for a time if they were loose in the flue holes in the sheet.

The flues were loose and could not leak, and since they did not leak, the fact that they were loose was not known till very rapid evaporation of the water in the small space surrounding them caused this space to fill with scale, under the bead and in the hole in the tube sheet, leaving the tubes exposed to the intense heat of the fire box with only partial protection from the water, causing cracking around the bead and splitting lengthwise of the flue inside the sheet, in many cases extending from the weld to the prosser impression.

This is a condition that does not exist when flues are not welded, because any looseness in the flue is manifested at once by leaking and must be repaired, which in turn prevents the overheating by putting the flue back to the proper position, tight against the flue sheet. However, with the attendant troubles that are common to tubes welded around the bead, the cost of boiler tube maintenance is greatly reduced and the chances for engine failures due to leaking flues is also much less, due to the fact that the welded flues do not open up and all leak at the same time as is often the case when flues are not welded.

It is not the object of this paper to detract from the practice of flue welding, for it has prevented many engine failures and saved many dollars in cost of maintenance, although welded flues did burn and crack and have to be rewelded occasionally, but on the other hand, to set forth a new method which has entirely eliminated the trouble that was common to the old method and explain the procedure to follow in resetting flues. This method makes of the welding, a major operation in connection with flue setting, with the same high degree of satisfaction that has been obtained in the use of welding in many other cases where welding has been employed as a means of construction, instead of as a supplement to some time worn practice.

Have flues cleaned and retipped as before but do not swedge as no coppers are required, clean off all scale at the end of the tube where it enters flue sheet so that there will be a clean metal contact between the tube and the sheet. Also see that the hole in the tube sheet is clean.

Cut the flues one-eighth of an inch shorter than if they were to be beaded, on both ends, set the flues in the sheet and roll tight, using as little oil as possible, so that no oil will get on the flue sheet around the flue as this will interfere with welding.

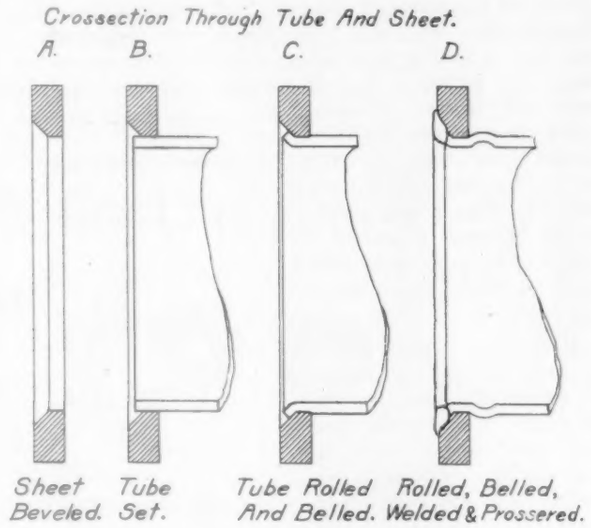


Fig. 2.

When the flues are rolled, about on eighth of an inch should project into the fire box or top end if it is a vertical fire tube boiler. This is illustrated in Figure 1, (at A).

Then proceed to weld around the end projecting through the sheet, being careful at all times to fuse into the flue end and the surface of the flue sheet, much the same as if welding around a bead. It is always better to begin at the bottom and work up to the top center on both sides of the flue depositing a fair sized bead as illustrated, on horizontal work. On vertical tubes make one continuous bead around the tube, then prosser with a sectional expander in the usual manner, after which it is best to roll the flue lightly to insure that there is perfect contact between the flue and the sheet.

This method has proven very satisfactory on upright dry top boilers, where it has been nearly impossible to keep flues tight even when welded in the old way around the bead.

In welding superheater flues a different method has been employed, although the essential features are the same.

The super heater flues being larger, 5⅜-inch diameter, nine gauge swedged to 4½ inches on the fire box end, were handled in the following manner, as illustrated in Figure 2, Cross Section Through Tube and Sheet, the different stages being designated in their regular order, A. B. C. D.

*Bend, Oregon.

First the flue hole in the sheet was countersunk at a 45 degree angle half way through the sheet, as at A. The flues were cut one-quarter of an inch shorter than if they were to be beaded, this means that the usual allowance was made for the bead on the front end of the flue, and the length is cut so that it will lack about ⅛ inch of coming through the sheet in the fire box, as shown at B.

This is done to make room for a substantial weld without having a projection of metal beyond the surface of the flue sheet, which would have a tendency to absorb heat.

After being rolled tight in the sheet the flue end is belled, or laid over in the countersink, as shown at C, after which the flue end is welded with a good substantial bead, fusing well into the end of the flue to make a strong welded joint as shown at D.

It will be found that it is much easier to make a good weld this way than when welding around the bead as before, due to the fact that the metals being welded are properly arranged for welding, the flue end is up tight to the beveled surface of the hold and all surfaces are clean, which is an important matter; whereas before when welding around a bead, it was impossible to have a proper welding condition because the arrangement was fundamentally wrong.

The copper ferrule very often is forced out of the hole by rolling and is compressed under the bead, contaminating the weld. Theoretically a bead on a boiler flue is upset back to the sheet and forms a solid mass of metal; but, the welder knows that all beads cover inclusions of foreign matter such as oil, soot, boiler scale and foreign substances which generate gas and cause streamers of flame to shoot out through the molten metal while welding, adding greatly to the difficulty of making a satisfactory weld and cause the formation of blow holes in the deposited metal.

Fig 3.
Old Method. Welded on Bead.

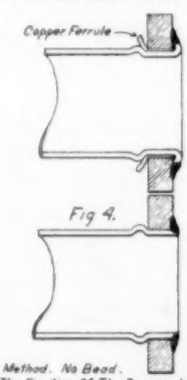


Fig 4.

New Method. No Bead. Note The Position Of The Prosser Impression Against The Sheet, Also The Positive Holding Position of The Weld.

A striking example of the efficiency of the new method of taking care of boiler tube troubles is furnished by three "dry top" upright boilers on our operation. These boilers are high pressure boilers operating under very severe conditions, the service being intermittent, the throttle is wide open and then shut off entirely at very frequent intervals, the exhaust is piped into the stack, making a very severe draught and the operating conditions are such that it is not practical to maintain an even water level, consequently the water is down to the minimum and up to the maximum many times a day.

Keeping the tubes tight in these boilers was quite a problem under the operating conditions, and perhaps the extent of the work necessary can be best understood when it is explained that the boilers involved are twenty-seven miles from the shop. The work had to be done on nights or Sundays, and mostly Sundays because it was impossible to do any work on them nights until the boilers had cooled. The only compressed air to operate tools had to be furnished by a locomotive. This involved working an engine and a train crew as well as the boiler gang.

After fighting these flues with the rolls, prossers and beading tools for a time we electric welded them around the bead, but due to the severe conditions under which they worked, they would not hold.

The high heat and low water, low heat and high water and various other detrimental conditions; one of which was the size of the flues, being 2½-inch diameter by 6 feet 10 inches long, forced the beads upward off the sheet, hinging on the weld till many of them broke on a line parallel with the bead at the juncture of the weld metal and the bead, or where the weld joined the boiler top sheet, due to the imperfections of the mechanical combination involved, by placing the weld at the outer edge of the bead where it was subjected to a thrust upward under expansion of the tube and a pull downward under the contraction strains; and not properly located to resist either, being at the outer edge of the bead with a section of the tube (the bead) turned over, on a horizontal plane interposed between the weld and the tube, at right angles to the lines of force exerted by the tube under varying temperatures.

Analyzing the case as stated and making a careful study of the defects, seemed to prove this theory, so a course of action was decided on that would eliminate as many of the imperfections of the old arrangement as possible.

Since the tubes were in good condition as far as scale or pitting was concerned, and an inspection disclosed that there was no accumulation of scale or mud on the water side of the lower tube sheet, it was decided to save the tubes by chipping off the bead and the old weld, so that a projection of the tube would be left above the sheet for re-welding, placing the weld in such a position that it would be properly located to resist the strains imposed under the severe operating conditions.

This can be readily understood by referring to Figure 3, showing the tube as chipped off, in solid lines, and the outline of the old bead and weld metal in dotted lines.

Figure 4 shows the action that took place under the old arrangement, with the weld located at the outer edge of the bead, which caused the failure of the flues at the top end.

At B, in Figure 4, is shown, a cross section view of the tubes as welded, which have given perfect service for the past twelve months, without requiring any attention, whereas, before the repairs were made they required repairs nearly every week and were leaking most of the time between repair periods, which impaired the operation of the machines to a great extent.

TOOL ROOM AND GENERAL WELDING

By George T. Kerr, Berkeley, Calif.

RC welding sets should be classed with machine tools, as arc welding is simply reversing the usual procedure. Instead of removing stock we add piece by piece, as in making a pattern for a casting, except that we allow no draft, and for no shrinkage, and as there is no rapping, as is required in castings, we allow no finish or very much less. When we have completed the piece we have our steel casting at about the labor cost of the pattern, or at least not much over the cost of simpler pieces. In comparison with a complicated pattern where core boxes would be required, the cost is much lower. Also time is saved and that is usually the most important element, particularly in tool work.

Now there are other things that can be done with a welding set, also aimed primarily at the same thing, "Time." One of these is making gages, of the snap gage type, although the possibilities are not confined to this type alone. The working surfaces are built up with a facing of hard material as also the faces or working surfaces of bedding blocks, locating surfaces, and so forth, for jigs and fixtures. These are ground as usual, no heat treating being required. It would be almost impossible to enumerate all of the uses of an arc welding set in the tool room. Any manufacturer who has none can certainly pay for one in six months, often much sooner.

Acetylene welding of production work is pretty thoroughly known, but special mention should be made of salvaging broken cast iron machine parts principally with the use of a torch and Tobin bronze. Put these in the hands of an experienced welder and the saving of time and money amounts to considerable. We force our machinery to the limit and very often beyond the limit. When a piece of machinery breaks

and you are two thousand to three thousand miles away from a new part, it is a case of weld it or make it, and we weld it. Also I want to remark that I have never seen a bronze weld fail if properly done.

These photographs were taken at the plant of the Hall Scott Motor Car Company, Berkeley, Calif.:

Figs 1 and 2 are good examples of arc welded jigs and fixtures. These tools are cut from steel plate, welded wherever practical, and normalized to remove welding strains before machining.

Fig 3 is an engine support originally made of malleable iron at a weight of two hundred eight pounds, redesigned for welding at a weight of one hundred and twenty-four pounds, and a saving of over ten dollars each.

Fig. 4 shows special machine parts welded. The bases are of 1½ inch plate and the curved parts of 2x4 inch machine steel.

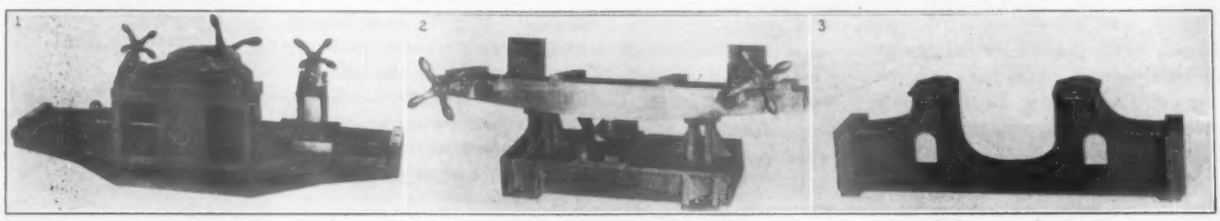
ner and reground. This cam shaft was for experimental purposes only. A and B, a Jones and Lamson Turret Lathe part reclaimed by arc welding with a hard surfacing electrode. A—Finished. B—Rough.

Fig. 8. Milling cutters are reclaimed by building up broken teeth with hard surfacing material. A—Rough. B—Finished. C—Broken cutter.

Fig. 9. Progressive drawing and blanking die.

Fig. 10. This die is in several parts. The hinged parts were rolled to shape, and the top and bottom parts welded on. The hinges were welded in place with the pins in, and no machine work was required to make the parts open and shut. This die is used to flange the two cylindrical parts shown, also to pierce the holes in them, using the same die or lower section.

Fig. 11. More dies, the piece on top and the one on the ground, for forming a sheet metal part were used as welded, no machine work being required.



Figs. 1 and 2—Arc Welded Jigs. Fig. 3—Welded Design Reduced Weight of this Engine Support 40 per cent.

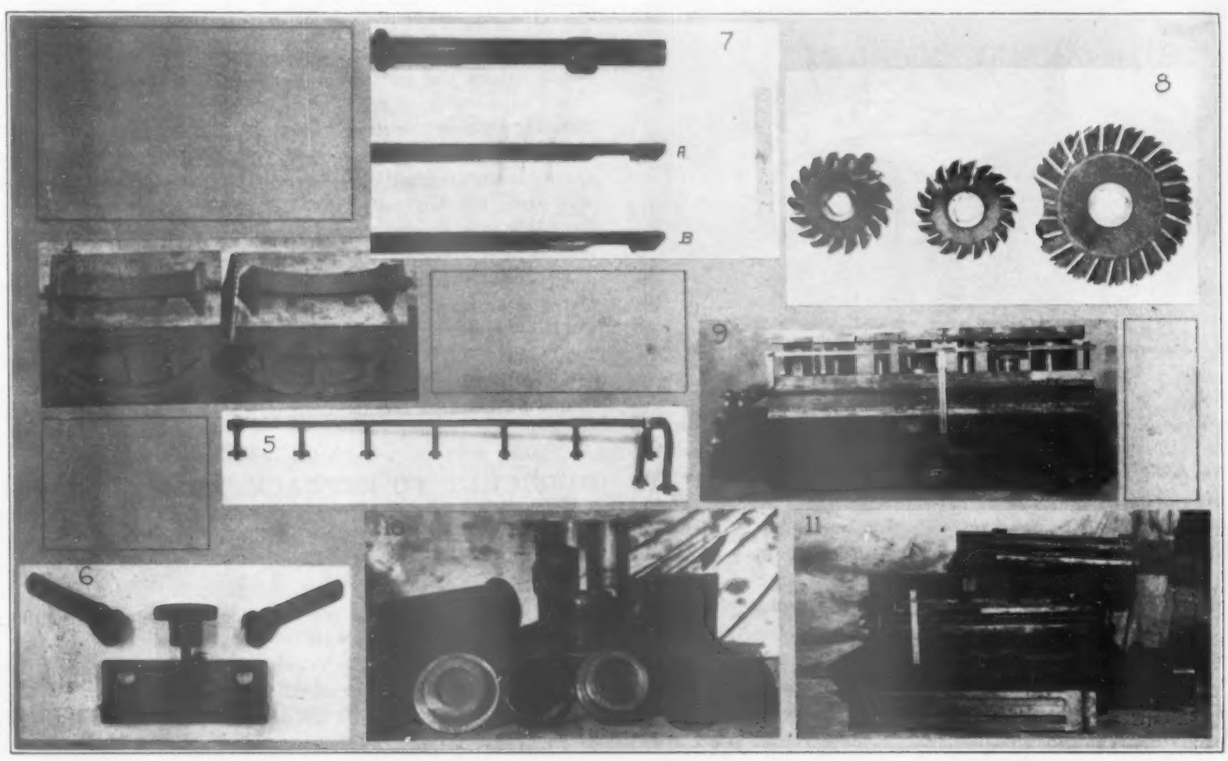


Fig. 4—Special Machine Parts. Fig. 5—Oil Manifold. Fig. 6—Arc Welded Jigs, With Hard Facing on Wearing Surfaces. Fig. 7—Lobe of Cam Shaft Built Up With Hard-Facing Rod. Fig. 8—Reclaimed Milling Cutters. Fig. 9—Drawing and Blanking Die.—Fig. 10.—Die Welded Up of Several Parts, and Pieces Shaped by It. Fig. 11—No Machining Required on These Dies After Fabrication by Welding.

Fig. 5 is an oil manifold, a regular production part, using ¾, ⅝ and ½ inch seamless steel tube and tested at one hundred pounds pressure for leaks, acetylene welded.

Fig. 6 shows small jigs arc welded, slip bushings welded to the handles, locating block faces, faced with hard facing material and finish ground before welding in place.

Fig. 7 shows one lobe of a cam shaft built up with hard facing rod. The other lobes were built up in a similar manner and reground. This cam shaft was for experimental purposes only. A and B, a Jones and Lamson Turret Lathe part reclaimed by arc welding with a hard surfacing electrode. A—Finished. B—Rough.

Fig. 8. Milling cutters are reclaimed by building up broken teeth with hard surfacing material. A—Rough. B—Finished. C—Broken cutter.

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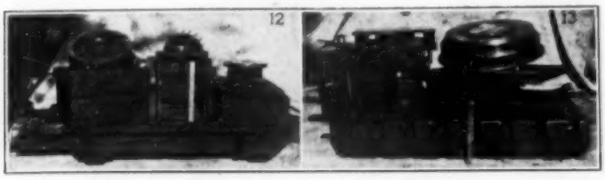
Fig. 10. This die is in several parts. The hinged parts were rolled to shape, and the top and bottom parts welded on. The hinges were welded in place with the pins in, and no machine work was required to make the parts open and shut. This die is used to flange the two cylindrical parts shown, also to pierce the holes in them, using the same die or lower section.

Fig. 11. More dies, the piece on top and the one on the ground, for forming a sheet metal part were used as welded, no machine work being required.

Fig. 12. The circular piece on top is a die for cutting laminated rubber and cloth. The product is ⅜x6 inches inside diameter and about 12 inches outside. The cutters for the outside diameter and the center hole are made of oil hardening tool steel, ½x2½ inches rolled into a circle and acetylene welded with vanadium weld rod. The piece is then normalized, machined, and hardened.

Fig. 13. More arc welded dies. The general appearance

of most of these tools is not artistic. We leave edges as they come from the cutting torch and our welds without any machining beyond sand blasting. We have had no failures



Figs. 12 and 13—More Arc Welded Dies.

with our welding and in most cases one piece or casting is all that is required. We have no pattern expense or pattern storage and no waiting for the foundry to supply castings.

AN EMERGENCY CUTTING AND WELDING JOB

Plant superintendents, contractors and others engaged in handling big jobs will be interested in the following description of an emergency cutting and welding job which was undertaken recently by a large bridge building concern.

While this application of the oxy-acetylene blowpipe concerns bridge building, yet such a problem may arise in an

Serious Loss of Time and Money Was Avoided by Cutting Out Anchor Bolts and Welding in Bolts of Proper Length.

industrial plant or on a contracting job. If the tools are at hand the difficulty is easy of solution.

An important highway bridge was about to be erected. materials were at hand and workers assembled. Steel construction was the next step. Then something was discovered which threatened to hold up operations.

In the concrete piers to support the bridge, anchor bolts had been sunk 5 ft. deep. There were seven of these concrete footings, each with four bolts to which the bridge posts were ready to be attached. The bolts were now found to be short by several inches.

To tear out the concrete piers and form new ones with longer bolts would be a very expensive procedure. To core out around the bolts deep enough to sink new ones properly, would be nearly as costly and not as satisfactory. A welding service operator, called upon for advice, pointed out a satisfactory solution. Cutting off the threaded bolt ends and welding on new lengths would give the desired extension.

The oxy-acetylene cutting blowpipe was employed to remove the threaded portion of each bolt. Then the remaining section of each bolt was bevelled with the cutting blowpipe to 45 deg., the same being done on the unthreaded end of each extension piece. The final step was to weld the extensions to the stumps. In doing this, a reinforcement of ⅛ in. was built up around the point. This assured entirely satisfactory strength and did not interfere with the function of the bolt, since the holes in the column base were somewhat oversize.

One welder and a helper did the entire job in less than three days. The bridge construction then went ahead on schedule.

WELDED PARKING SIGNS

The parking problem is getting to be an almost universal one. None of our cities were laid out with the thought of taking care of the enormous number of automobiles in use today. Cities are obliged to protect the safety and utility of boulevards by establishing parking restrictions, and individual concerns are likewise forced to provide for their own requirements by establishing packing restrictions both on the streets on which they are located and the property surrounding the plant. Neat and durable parking signs can be fabricated quickly and economically from either stock materials or scrap materials by the oxy-acetylene torch. The illustration shows two sides of metal parking sign made by the Modern Engineering Company, St. Louis, who are manufacturers of "Meco" oxy-acetylene welding and cutting equipment. The fabrication of such signs is a simple matter and welded joints insure the maximum durability of one-piece construction. In another large plant where it was desired to establish definite parking locations for the automobiles used by employees, welding was also used to good advantage. Definite spaces were assigned for different employees and a little sign was made for each one. In order to make sure of their being durable it was decided to make them of metal and weld them; so instead of a wooden stake a small length of angle iron pointed at one end was used. For the marker itself a piece of quarter-inch plate of about 16x2 inches was used. This, of course, was welded to the angle iron post. The individual name was painted with a good metal paint on the marker. These markers have proven very satisfactory and have eliminated all confusion incident to the parking of cars on the ground of the company by employees.

These Parking Signs Are All-Welded.

DIFFICULT TO REPLACE: EASY TO REPAIR

There are on the market today many automobiles of foreign manufacture. Some of these maintain large assembly depots in this country where stocks of spare parts are kept on hand for replacement. Others have not made any plans for service in this country, and as a consequence it is sometimes difficult to get necessary repair parts.

This was the case in the repair of a foreign car which came to a welding shop a short while ago. Not only was the aluminum crank case broken, but the bearings caps were also rendered useless. The cracks in the crank case were repaired by ox-welding and the owner of the car meanwhile went to the office of the manufacturers of this motor car, a foreign firm, with the intention of getting new bearing caps. He found that they did not have any in stock, and to order from Europe expressly for him would entail a long wait and a great expense.

So he returned to the welding shop and had the bearing caps oxy-acetylene welded. These caps were of cast aluminum and measured about 2½ in. across, the metal being about ½ in. thick. Obviously, the amount of money saved was considerable, but, far more important, the amount of time saved alone more than made up for the cost of welding.—Oxy-Acetylene Tips.

Steel Storage Tank Construction

Reasons for Welding, and Methods Used in Welding Roof and Bottoms on Tanks Up to 152′ Diameter by 42′ High, and Up to 125,000-Barrel Capacity

By E. C. Moore*

THE electric arc is gradually supplanting the punching machines and pneumatic riveters in the construction of large steel tanks for oil storage on the west coast. As yet the welding process is applied only to the tank bottom and roof. In the future, if we follow the lead our Australian neighbors, we may extend the use of welded joints to include those in the tank shell.

The particular advantages of welding the seams of the bottom and roof plates are as follows:

1. *Shop fabrication is eliminated. This decreases cost.*
2. *The need to construct the tank bottom on horses and cribbing in order to buck-up rivets from the underside is eliminated. This decreases cost, since the welded bottoms are laid directly on the grade.*

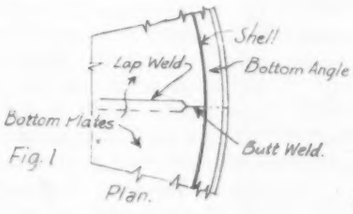


Fig. 1

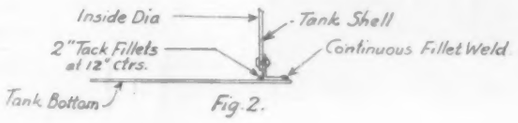


Fig. 2.

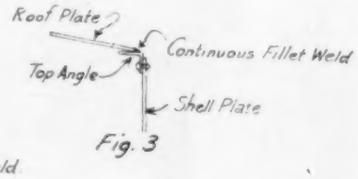


Fig. 3

3. *Both roof and bottom are tighter, a very essential point in the storage of petroleum products.*
4. *Welded bottoms should last longer without maintenance than riveted bottoms. This point is unproven as yet, since this type of construction is so new, but it seems logical to assume that if the weld resists corrosion as well as the plate itself, that the life of the plate is the life of the bottom. In riveted bottoms the corrosion of the rivet heads caused the development of leaks long before the plates themselves were beyond usefulness. The result was that the tank had to be taken out of service, thoroughly cleaned and the bottom repaired. Incidentally those repairs have, for several years, usually cosisted of welding along the plate seams and over the old rivet heads.*

So, on the whole, though perhaps not apparent at first glance, the use of welded construction may be said to be better and cheaper. What other justification is needed?

"Is it strong enough to be safe?" The old cry. Well, what strength is needed? In a tank bottom laid on a properly prepared grade there are no streets in the bottom plates. Tank roofs nowadays are designed for a 25 lb. sq. ft. live load and rafters are spaced not greater than six foot centers. No great stress will occur there surely. The old idea that a heavy bottom angle thickly studded with large rivets in both legs is required in order to connect shell and bottom together is a fallacious one if it is thought to be required for strength. The rivets had to be large because the angle and plates were thick. They had to be close together in order to caulk tightly the angle against the shell and the bottom against the angle. Tanks of several thousand barrels capacity have been constructed, and are giving satisfaction, where the shell is connected to the bottom plates by only a small fillet weld. No angle at all. We are not advocating that though, at least not just yet.

There follows an outline of the procedure in constructing a tank with welded bottom and roof and illustrations of details of the angle connections.

Bottom plates are laid on the prepared tank grade, lapped a minimum of 1 inch and tack-welded in position. Sketch plates may either be cut to shape in the shop or with a torch in the field. In order to secure a smooth bearing for the bottom angle where it crosses the sketch plate joints, the sketch plates should be notched half the width of the lap for a short distance on either side at the outer end, and the point changed to a butt joint underneath the bottom angle. See Fig. 1.

After the sketch plates have been butt-welded at the ends, the bottom angle may be laid and tack-welded in position. Work may then proceed with the erection of the riveted shell. It is considered advisable to have the weight of one or more shell courses on the bottom angle to insure its being brought down snugly against the bottom plates before it is finally welded. Fig. 2 shows the method of placing the bottom angle.

The bottom seams may now be welded-up with continuous fillet welds and the bottom angle welded with a continuous fillet and at the toe and 2 inch tack fillets at 12 inch centers at the heel.

If the welders are placed symmetrically about the tank bottom, start at the center and weld out toward the perimeter first along the longitudinal seams, then along the cross seams, the result will be a bottom remarkably free from warps, even of the degree that commonly occurs in riveted bottoms.

After the shell and roof supports are up, lay the roof plates with a ¾ inch minimum lap, tack-weld them and proceed as in welding the bottom. The ends of the roof sketch plates need not be notched. They are welded along the perimeter to the top angle as shown in Fig. 3.

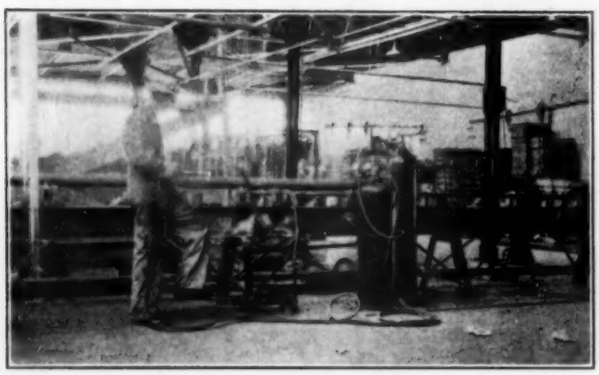
The bottom may be tested at any time after the first shell course is riveted up. Testing is accomplished by forcing oil beneath the bottom, either through a line to the center buried in the tank grade, or through a temporary line run in through the manhole and connected to a flange provided at the center of the tank bottom. A low dike is constructed around the tank and sufficient oil forced through the line to give a 6-inch head. Leaks in the bottom then appear on the inside and may be caulked or welded.

*Union Oil Company of California, Los Angeles.

FIXTURE FOR BUTT WELDING CAST IRON PIPE

Cast iron pipe made of special mixture designed to withstand corrosion in chemical plants and sewers is cast vertically in six-foot lengths by a Middle Western plant. The attempt was made to bronze weld the six-foot lengths to make up longer lengths but with little success. The peculiar grain and other characteristics of the special mixture made bronze welding so difficult that it was given up as impracticable. But in the course of experimentation it was discovered that 6-inch and smaller diameter pipe could be welded with cast iron filler rod very readily and with practically no difficulty from cracking or checking. Preheating was unnecessary, and hence the problem of making up 20-foot or other lengths was solved so far as welding procedure was concerned. The next step was to devise shop equipment that would facilitate the butt welding operation, and the fixture shown in the illustration was finally worked out.

The fixture comprises two 9-inch steel channels, 22 feet long, placed back to back and separated about 4 inches.



Butt Welding Cast Iron Pipe.

The legs were made of 3-inch angles bent to form the supports and the cross member at the top which form the tie to hold the channels in position. The channels were welded to the cross members of the legs, and the braces also were welded.

The design of the fixture required sets of rolls with axes parallel to the pipe axes and rolls at right angles to the pipe. The first set of rolls is to support the pipe and facilitate turning it during the welding operations. The second set is to support the pipe so that it can be moved freely longitudinally when a weld is finish, and another section is being brought into place for welding.

This dual arrangement of rollers requires that means be provided for lifting the longitudinal acting rollers when the pipe is to be shifted. Forked levers were made carrying rolls at the upper ends and having pivot holes in the center and holes at the bottom for attachment ot the actuating bar. These levers are mounted between the channels on short shafts set crossways and bronze welded to the top of the channels. The levers are connected at the bottom to the horizontal actuating bar, and to this bar is rigidly secured another bar bent at right angles and pivoted to a hand lever. When the hand lever is pulled to the right the levers elevate the pipe, raising it clear of the so-called welding rolls, and then the pipe can be easily moved longitudinally for the next weld. Releasing the hand levers allows the pipe to settle down into the welding rolls.

The operator stands beside the pipe with one foot on a foot lever connected to a ratchet that actuates a longitudinal shaft on which one of each pair of the welding rolls is mounted. As the weld proceeds he actuates the foot lever and turns the pipe with the ratchet. All pipe is beveled by machine to approximately 45 degrees angle.

A 4-inch cast iron pipe butt weld is made with this arrangement in about 10 minutes, using cast iron welding rod, and a 6-inch pipe is welded in about 16 minutes.

In making up 20-foot lengths, three 6-foot and one 2-foot lengths of pipe are used. Other combinations are made such as two 6-foot lengths for 12 feet, and so on. All welded pipe is tested by hydraulic pressure, up to 1,000 pounds per square inch for the 4-inch size.

The fixture was developed and built under the direction of the Applied Engineering Department of the Air Reduction Sales Co., New York.—*International Acetylene Association Forum.*

THE WORKER'S HEALTH

By Helena L. Williams

Good health is the concern of every working man and woman. Not to have it means the loss of the good things of life, for the comforts that a full pay envelope provides are reduced when disease attacks the body. Not only the individual himself suffers, but often the entire family, and worry, itself a dangerous ill, becomes an additional hindrance to recovery.

Yet it is not very difficult for a normal person to keep in good physical condition. Nature is a good doctor and, given half a chance, she will repair a good deal of damage. One of her best assistants is moderation in living. An overloaded stomach, overtired muscles or an exhausted brain cannot be kept in normal functioning order indefinitely. Neither can an undernourished body, flabby muscles and an idle mind.

The human body needs three square meals a day, the amount and kind of food depending a good deal upon a person's job. The mechanic needs heavier food and more of it than the desk worker; the former burns up more energy and so requires more fuel. Both, however, need properly balanced meals consisting of starches such as potatoes, macaroni and cereals, and green vegetables such as spinach, cabbage, green peas, beet greens and kail. They should drink plenty of milk; and meat once a day is enough. A hot noon hour lunch is better than a cold lunch.

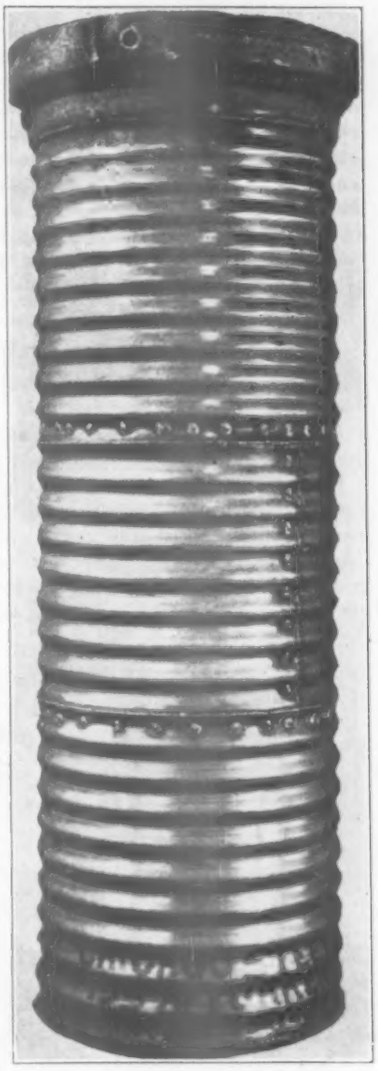
The amount of rest and exercise the worker requires also depends largely on his occupation. A steel worker needs to rest his tired muscles; the office worker should do regular exercises at home or in a gym. Both, however, may be in need of recreational exercise such as baseball, swimming, rowing and dancing. These not only give the body activity but at the same time are a mental tonic.

Overwork is dangerous to health because the body needs sufficient rest to throw off the fatigue poisons that accumulate with mental and physical exertion. Fatigue, though a natural and healthy condition, must not become too great a burden to the blood and nerves. Of fresh air no normal person can have too much. Even in cold weather bedroom windows should be opened at night.

A yearly physical examination by a good physician is an investment in health. Small disorders can be discovered by this means and treated with little expense and loss of time, whereas to wait for them to "wear off" means courting serious trouble later. Tuberculosis, for example, begins with such ordinary symptoms as a cold that hangs on, slight cough, loss of appetite and lasting fatigue. Patients who go to the doctor in time and take treatment have a good chance of recovery. As the disease progresses, the possibilities of checking it becomes less and less. One of the most important phases of the anti-tuberculosis campaign is to educate the public to recognize the early symptoms and go to a sanatorium in time. To further this and other work, the National Tuberculosis Association and its affiliated bodies are conducting the twenty-first Christmas seal sale in December.

WELDED STAINLESS STEEL ANNEALING POT CUTS WEIGHT AND COST IN HALF

Considerable interest was displayed at the Steel Treater's Exposition in Philadelphia in a new designed annealing pot which offers a solution of many heat treating problems. The Fuzon Annealing Pot, manufactured by the Chicago Steel & Wire Co., Chicago, proved conclusively that stainless steel could be successfully welded.



Reduced Weight Is a Big Factor in the Use of this Pot.

According to the manufacturers, annealing cost figures with this new pot show that the time of annealing is almost cut in two, and the cost of annealing is decreased almost 50 per cent. The Fuzon Pot, which weighs no more than 660 pounds, takes the place of a cast steel pot weighing 3,300 pounds. Both pots hold approximately two thousand pounds of wire. Consequently, when annealing wire in the new stainless iron pot, it is only necessary to heat 2,660 pounds of metal, whereas with the old cast steel pot 5,300 pounds of metal must be brought up to heat. Furthermore, with stainless steel pots—where there is no scaling action whatever—the life of the pots will be extended almost indefinitely.

The Fuzon Annealing Pot is about seven feet high and has an outside diameter of about twenty-four inches. The body of the pot is made of 18 per cent cromium with 8 per cent nickel stainless iron. It has a wrought steel base plate seven-eighths of an inch thick and a wrought steel collar on the top about one inch in thickness. Eight carbon steel rods, one-half inch in diameter, are welded to the collar and to the base to take the lift. A steel plate is welded inside of the pot so that the coils of wire can easily be removed and would not be caught in the corrugations of the outside shell.

The shell of the Fuzon Pot is made of 14 gauge stainless iron. It is first formed and riveted—the riveting being primarily for the purpose of retaining the proper shape and not to afford extra strength.

The Pot on exhibition at the convention had been put into service in wire mills during the middle of July, and between that time and the first of October it had been in and out of the furnace approximately seventy-five times and had been up to the annealing point for several hundred hours. There was not a sign of a hair crack at any of the welds when examined under the microscope at the end of this time, nor was there any sign of crack or fracture at the top or bottom weld where the stainless steel was welded to a wrought steel collar and base plate. Because of the marked difference in the co-efficient of expansion between stainless iron and the mild steel, it was thought that trouble might develop at these points, but when the weld was made with the stainless iron 18-8 combination welding rod, it was found that the ductility of this weld was sufficient to take care of the difference in expansion and contraction of the two metals when heated.

RECENT PRESSURE GAUGE DEVELOPMENTS*

The continued and gratifying expansion of the oxy-acetylene industry is a direct result of intelligent industrial engineering in the field, coupled with a corresponding improvement in the apparatus itself, and a sales schedule which has brought these devices within the reach of a greatly increased number of users.

Improved manufacturing methods, and standardization, have done much to render these results possible. This same urge for better apparatus at more attractive price schedules has been felt not only by the manufacturers, but also by the makers of the various accessories utilized by the industry. This has perforce made necessary considerable research work, as well as new mechanical development, so that an article of equal or higher merit and lower cost might supplant the former standards. At the same time these new standards received the supervision of the Underwriters Laboratories, thus assuring the former high degree of quality. Just how the gauge industry met these changing conditions may be briefly set forth, as follows:

In the early days of the industry it was universal practice to supply a 3½-inch 3,000-pound gauge for high-pressure oxygen, a 3-inch 400-pound or 500-pound gauge for high-pressure acetylene, and a 2½-inch 30-pound or 50-pound gauge for low-pressure acetylene and oxygen respectively. All of these gauges were furnished in heavy, highly polished cast brass cases. The high-pressure oxygen gauge was fitted with a steel Bourdon tube.

The first departure from the above practice lay in the substitution of a high-quality bronze tube for the steel tube, thus effecting a material manufacturing saving besides eliminating corrosion of the steel tube in contact with moist oxygen.

This was soon followed by the substitution of a 3½-inch pressed brass, knurled case and ring gauge, instead of cast brass. Nothing was sacrificed in this change, and the weight was materially reduced.

It was soon found that by the use of a suitable non-ferrous Bourdon tube, an equally reliable gauge might be produced in the 2½-inch size, and that in so doing a still further price reduction was possible. This led to gradual adoption of pressed brass gauges of uniform dial diameter of 2½ inches, for both high- and low-pressure use.

Standardization on this size and structure by the various apparatus manufacturers has made possible the present contribution of the gauge manufacturers to the development program of the industry.

It has also been found possible to produce in diameters approximating 2 inches, a very satisfactory line of gauges for smaller and lighter apparatus, where small size and minimum weight are essential features.

In conclusion it may be said that the cast construction utilizing steel tubes is virtually obsolete, and that the industry is gradually standardizing on pressed brass, knurled cases and rings, non-ferrous alloy Bourdon tubes, and uniform 2½-inch dial diameters.

**Extract from the report of the Oxy-Acetylene Committee of the International Acetylene Association, presented at the 29th Annual Convention, Chicago, Nov. 15, 1928.*

PERMANENT INTERNATIONAL COMMISSION OF ACETYLENE AND ACETYLENE WELDING

The Monthly Circular (No. 7) states that the President proposes to call a meeting of the Commission in Paris for the 8th Session, on Friday 18th and Saturday 19th, January, 1929. The

first meeting will open on Friday, 18th January, at 2:30 p. m., and that on Saturday morning, at 10 o'clock.

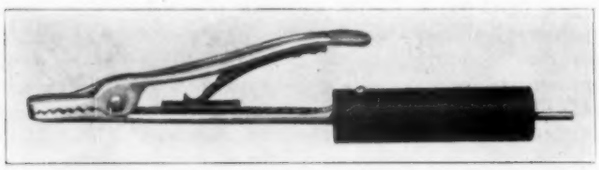
Members of the Commission who have questions to put are requested to send these to the Secretary before 8th December.

The Chambre Syndicale de l'Acetylene et de la Soudure Autogene cordially invite all the members of the Commission who are present at the 8th Session to a General Assembly, on Saturday, 19th January, 1929, at 4:30 p. m., and a Banquet which will take place the same evening at 8:30.

Those members who are not able to be present for the Session are requested to notify the Secretary before 10th January.

NEW ELECTRODE HOLDER PRODUCED

The Federal Face Shield Company, of Columbus, Ohio, announces the New Ideal Electrode Holder. This holder is made of Manganese Bronze in two sizes, No. 1 for light welding, and No. 2 for heavy work. Two sizes are considered essential when performing all classes and grades of work. Among the features of this holder is the three leaf spring which produces a firm grip on the electrode at the same time permitting release by a



New "Ideal" Electrode Holder.

slight pressure of the thumb. Insulation provides assurance that the spring will not become heated due to carrying part or all the current load. Another feature of the holder is the concealed manner in which the jaws are pivoted, so that accidental burns or arcs will not weaken the hinged portions of the holder. The fiber handle provides proper insulation for the safety of the user.

PAMPHLETS ANNOUNCE IMPROVED TYPES OF BUTT WELDERS

Two new circulars issued by The Federal Machine and Welder Company describe and give specifications of two improved types of butt welders. The new Type No. 80 was developed by the Federal engineers along the flash butt-weld principle to meet the urgent demand of manufacturers engaged in quantity production of automobile rims. Type No. 82 was developed primarily for the production of the heavier types of automobile and agricultural wheel rims. Both of these machines have met with success in other fields of production such as welding steel reinforcings for pipe, welding brake carrier flanges to rear axle housings of automobiles, welding various types of fabricated steel beams, shrink rings for threshing machines, etc, The production capacity of machine No. 80 is claimed to be 500 automobile rims, size 4½" by $\frac{3}{32}$", per hour. The capacity of No. 82 is given as 200 eight-inch balloon tire rims per hour.

ELECTRIC ARC WELDING IN GREAT BRITAIN

The Industrial World, an English publication, recently contained an interesting article by Mr. H. Oswald Erdon entitled "Progress in Electric Arc Welding." Among other things it described a large welded pipe line which was constructed as part of Sabie River Hydro Electric Power Station in South Africa. The pipe was about 36 inches in diameter and the line was layed down over a rough and hilly country. When the job was completed it was given an hydraulic test up to a pressure of 200 pounds, and only a few minute blowholes in the welding were discovered. The South African Electricity Supply Commission were the contractors and Alloy Welding Processes, Ltd., supplied the electrodes which were of the flux covered type.

WILLIAMS & COMPANY PREPARE COLOR CHART FOR WELDING WIRES

A "Welding Chart" illustrating in actual colors the labels on all of the welding wires handled by Williams & Company describes each of these gas and electric wires, giving sizes, amperage to be used, polarity, tensile strength, and uses for which each wire is particularly suitable. The line includes the Wilson "Color-Tipt" and the Williams "Weldflo" and "Norflo" wires. Welding information applying to various classes of jobs is also included, as well as tables of melting points and tensile strengths of metals, and diameters of wire recommended for welding various thicknesses of metal. The chart, made up on heavy stock suitable for mouting on the wall, may be secured by addressing the company at 901-937 Pennsylvania Avenue, Pittsburgh, Pa.

OXWELD HELMET GOGGLES

Accessories for welding and cutting recently added to the line of the Oxweld Acetylene Co., 30 E. 42nd Street, New York City, are the Oxweld Cap and Skeleton Type Helmet Goggles.

The No. 9 Cap Type Goggles, Fig. 1, consists essentially of a strong fibre cap, to which a pair of goggles are attached by means of fibre links. The goggles can be readily raised over the forehead or lowered over the eyes with one hand. The bridge is adjustable and is covered with rubber insulation. Replaceable lenses, in the same size and colors as are supplied

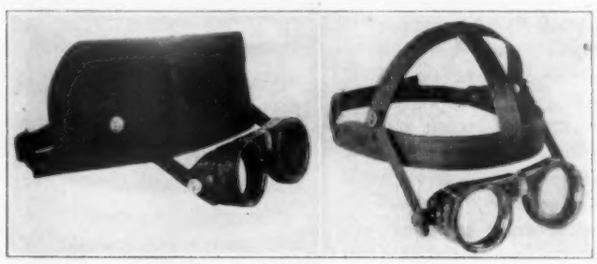


Fig. 1. Fig. 2.

in Oxweld No. 6 goggles, are used, the colored lenses being protected by cover lenses of clear glass. The No. 10 Skeleton Type Goggles, Fig. 2, are the same except that the Goggles are attached to a lattice skeleton cap. Both styles are provided with leather straps at the rear for head-size adjustment.

These Cap and Skeleton Type Goggles furnish adequate protection and are very durable. They have been found, by welders who have used them, to be extremely comfortable and convenient.

NEW REID-AVERY ELECTRODE, TYPE "B"

Reid-Avery Company, Philadelphia, Pa., have placed on the market Raco Composite Type "B" electrode for arc welding. This new electrode is of standard .13% to .18% carbon analyses, with each wire possessing lengthwise grooves rolled into its entire length. These grooves are filled with an arc-stabilizing agent. Due to its construction the makers say they are able to guarantee absolute uniformity, with no rejections from any cause whatsoever. This electrode is also said to possess splendid penetration and high welding speed. According to the makers, Raco Composite Type "B" wire was perfected with a view to avoiding inequalities of bare wire, and the arc stability of this new wire is so perfected that it may be used with equal success with either d.c. or a.c. current, where flup coated electrodes have been considered nccessary. The cost of the electrode is no more than that of a good grade of bare wire. Reid-Avery Company also manufacture Raco Composite Type "A" wire for automatic arc welding. Following the unusual success of this it was decided to develop and place on the market the type "B" wire.

NEW ITEMS IN TORCHWELD EQUIPMENT

The Torchweld Equipment Company of Chicago, Ill., have recently added several items of interest to their line of welding and cutting equipment. Among these are their new No. 18MC cutting torch of one-piece tip construction, and their No. 28MC two-piece tip construction cutting torch. These torches are entirely new and have metal to metal seats on their high pressure and low pressure lines. They also have flash back and back pressure safety features to prevent flashing. They are made from die pressed metal and solid bar brass stock.

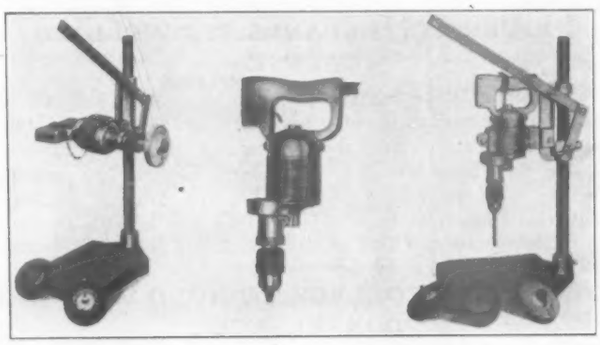
Another feature is their new cutting attachment for their Nos. 1-2 1-22-2-3-4 and 6NF welding torches. It can be used for cutting metal up to eight inches in thickness and has the safety flash back chamber for preventing flashing of the gases through the torch.

Their new welding torches, Nos. 30-31-40 and 41, are suitable for automobile, aeroplane, and sheet metal welding of different thicknesses. They also have the Torchweld non-flash patented construction.

Another item to be mentioned is the new automatic attachment for their Nos. 1-21-2-3-4 and 6NF welding torches which shuts off both gases when production welding is being done, allowing the operator to set up his work. When relighting the torch no adjustment is necessary at the needls valve, nor do the gases have to be shut off at cylinders or generator. It is obvious that this is a very desirable attachment for those engaged in production work.

NEW PORTABLE ELECTRICALLY DRIVEN GENERAL-PURPOSE DRILL

The Wodack Electric Tool Corporation of Chicago has just announced a new development of theirs in the field of portable electric drills. This is an electric hand drill weighing 7½ pounds with a capacity of ⅜ inch and powered with a G. E. Universal Motor of the variable speed type. Besides drilling it can be used



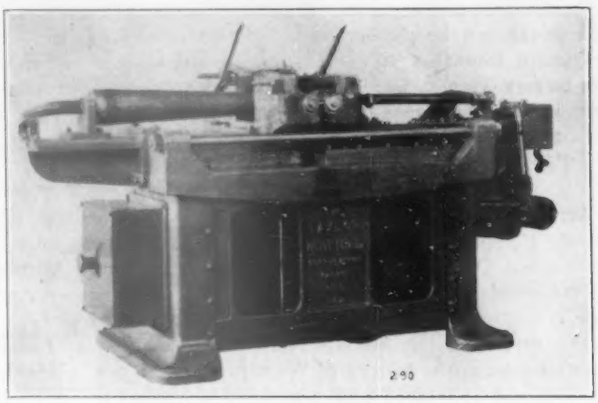
A New Combination Portable Tool.

for odd jobs of grinding and buffing, thus further increasing its utility. As indicated in the illustration, a stand may be furnished along with the drill. This is constructed so that it will hold the drill in a vertical position for drilling or horizontally for grinding, thus more completely following out the idea of giving the public a general purpose tool.

SPECIAL BUTT WELDER FOR FABRICATING MUFFLERS

Another special Taylor-Winfield electric welder for automotive welding is finding favor, so it is reported by its makers, for one of the many phases of work in the automotive industry.

This machine, designed and built by The Taylor-Winfield Corporation, Warren, Ohio, is for welding the various gauges of stock used in fabricating mufflers. It is known as a type B-11 special. It is daily becoming more popular for accurate and uniform welding. The machine is motor-driven, the timing of the current and upsetting of the weld is accomplished by adjustable cams, which entirely eliminates the human element of the welding operation. This method also insures practically 100 per cent perfect welds with less expensive labor, the appearance of the welds being more uniform and of higher accuracy. On this particular job the heads of the muffler are welded to the body, also the intake and outlet



Taylor-Winfield Butt Welder for Automotive Welding.

tubes are welded to the head, making an entirely electric welded muffler.

This firm has produced many special types for simplifying and economizing production in automotive plants, as well as many models for other industrial purposes.

G. E. BULLETINS ANNOUNCE NEW DEVELOPMENTS IN ARC WELDING EQUIPMENT

Two bulletins, GEA-881A and GEA-569B have recently been distributed by the General Electric Company. GEA-881A describes a new gas driven General Electric Arc Welder supplying a welding current which makes the user independent of local power limitations. The generator is powered by a 23 horsepower Continental gas engine. Bulletin GEA-569B describes their new constant-potential arc-welding set for any number of operators up to the capacity of the machine. They of course handle either metallic or carbon electrode welding and are claimed to be particularly adapted to automatic welding.

ALLOY WELDING PROCESSES, LTD., ANNOUNCE PORTABLE ELECTRIC WELDER

In their new bulletin, No. 54, Alloy Welding Processes, Ltd., of London, England, emphasizes the use of portable welding equipment aboard ships, mentioning the fact that such equipment is now found on every warship larger than the destroyer class. There it has been successfully used in making important repairs while at sea, and has thus saved the navy immense amounts in towing charges and shipyard repair bills. The bulletin suggests the use of such equipment on all vessels of the Merchant Marine.

NEW MICROSCOPE AIDS IN MAKING BRINELL READINGS

The ever increasing use of the Brinell-Hardness test in industry has made it necessary to perfect the existing lens and measuring microscope devices, which are essentially adapted to laboratory use; or even to replace them by another instrument which would afford absolutely trustworthy measurements. This is particularly important for those plants in which the guarantee of a definite degree of Brinell-Hardness is required in the specification of parts.

Several advantages are claimed for the new Busch-Schumann

Projector, some of which are the elimination of focusing, the image appearing immediately (even when the rim is rounded) as a sharp edged image on a ground glass screen and magnified 10 times. It is read with both eyes, thus reducing eye strain. Simultaneous readings can be made of two diameters, and other diameters read simply by rotating the screen. The image is always bright because of the enclosed illuminator, and perpendicular lighting of the test-surface avoids disturbing reflections.

Greater accuracy, especially in unskilled hands, is also claimed. The image can be photographed for record purposes, and the instrument may also be used in testing various raw materials, for forgery examination, for examining paper and fabric products, and also finds uses in watch making, medical work, etc.

THIRTY-DAY CRUISE COMPLETED BY STOODY FOKKER

Arriving some twelve hours ahead of its schedule, the Stoody Company Fokker Super Universal Monoplane, piloted by Vernon Dorrell, arrived at the Stoody Company Airport on the evening of November 2, completing an eight thousand mile cruise of the United States in eighty flying hours.

The return of the Stoody Plane to its home port marks the first time in the history of Western Aviation that a private concern has sponsored and completed a successful flight of this type in a privately owned plane. Furthermore the completion of this trail-blazing cruise of the Stoody Company will undoubtedly lead other manufacturers to attempt such an advertising and publicity campaign as the one the Stoody Company recently completed. Although the cost of such a trip as this is high, the returns more than compensate the expenditures necessary to complete a cruise of this caliber.

During the flight, the Fokker visited some twenty cities in the United States where Stoody Products are being distributed. On the trip from New York, the plane stopped at the International Petroleum Exposition. Here the plane was used to give the guests of the Stoody Company courtesy flights.

J. C. Blake, Stoody Sales Manager, stated upon returning to the home office of the Stoody Company, that the trip was pleasant during the entirety. There were very few discomforts experienced by the passengers and according to Blake, the transaction of business by use of airplane is the only thing. Blake is a great enthusiast for the promotion of aviation by commercial processes.

WESTINGHOUSE WELDING ENGINEER RESIGNS

A. G. Bissell, prominent welding engineer for the Westinghouse Electric & Manufacturing Company recently resigned from that company. Mr. Bissell plans on entering the industrial field as an independent consultant in arc welding engineering on the Pacific Coast.

Mr. Bissell is a graduate of the University of Washington, holding both a B. S. and a C. E. degree. His entire career has been spent in the arc welding industry. Prior to entering the employ of Westinghouse in 1923, Mr. Bissell was arc welding Metallurgist, U. S. Navy Yard, Puget Sound Washington: arc welding engineer, Boering Airplane Company, Seattle, Washington; and Superintendent and Engineer of the Arc-Weld Furnace Company, Seattle.

NEW LINCOLN BOOKLET TELLS HOW TO DESIGN FOR WELDING

The Lincoln Electric Company have recently published a supplement to their 160 page text book, "Arc Welding—The New Age in Iron and Steel." The new booklet contains thirty-two pages and is entitled "How to Begin the Application of Arc Welding in Production Manufacturing."

The bulk of the text is devoted to the redesign of machinery and the principles involved are set forth in such a manner that no designer can fail to find the text helpful.

In developing the theory of arc welded design many line drawings have been used which show clearly how standard steel shapes are utilized to build up structures which formerly would be cast.

Along with these theoretical designs, however, are shown photographs of similar designs which are in actual use.

The supplement is a convincing proof of the rapid strides which are being made in the substitution of arc welded steel for cast iron as many of the forecasts made in the original text are seen as proven facts in the supplement.

The Lincoln Electric Company plans to distribute the supplement without charge to all present owners of the parent text book. Individual copies of the supplement can be obtained at a small charge from this company.

ANNUAL MEETING OF COMPRESSED GAS MANUFACTURERS' ASSOCIATION

The date for the Annual Meeting of the Compressed Gas Manufacturers' Association has been set for Monday, January 21, 1929, and the necessary arrangements have already been made to secure the use of the same rooms at the Astor Hotel, New York, that were used last year. The program committee is arranging a program of unusual merit and it is hoped that an even larger attendance than ever before will be obtained.

ARC WELDING ACCESSORY PUBLICATION

A recent publication of the Westinghouse Electric & Manufacturing Company, Leaflet No. 20398, describes quite a number of the welding accessories which they offer for users of arc welding equipment. The equipment discussed in this leaflet includes protective welding helmets, hand shields, metal electrode holders, carbon electrode holders, welding cable, and welding circuit reactors.

UNIVERSITY EXPANDS ITS WELDING COURSE

The North Texas Agricultural and Mechanical College, of Arlington, Texas has found it necessary to expand its welding course to include electric arc welding. As a part of this expansion they have installed one General Electric 300 Ampere machine and one Lincoln Stable Arc 200 Ampere machine. With this equipment they feel that they will be able to teach the fundamentals and give experience in this phase of welding.

IOWA STATE COLLEGE TO HOLD WELDING CONFERENCE

The Iowa State College of Agriculture and Engineering will hold a state Welding Conference at Ames, Iowa, on January 16th, 17th, and 18th, 1929. An interesting and practical program has been arranged and will be found to be of interest to all those connected with any phase of the welding industry. No fees will be charged, and the conference will be open to all, whether from Iowa or other states. Those desiring advance copies of the program may obtain them by getting in touch with the Engineering Extension Service, Iowa State College, Ames, Iowa.

G. P. A. MEETS NEXT MONTH

The Gas Products Association will hold its Winter Meeting at the Palmer House, Chicago, January 15 and 16, 1929. It will differ from previous similar meetings of the association in that only active and associate members will be invited. The reading and discussion of technical papers, of which there have been several heretofore, also the usual banquet, will be dispensed with, and business pertaining more especially to the association affairs rather than those relating to the industry, will be discussed.

Tobin Bronze Welding is saving time and reducing costs in repair shops and manufacturing plants all over the country.

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for oxy-acetylene welding

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Brazing Metal	1634°F
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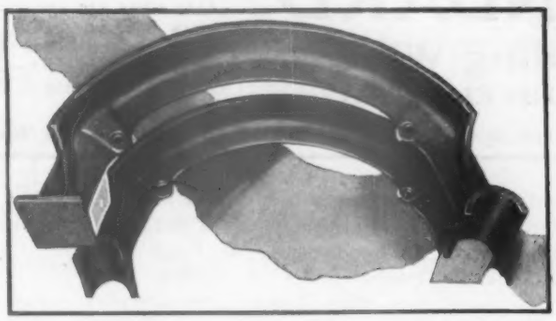
Everdur	1866°F
Ambrac	2102°F

for arc welding

Phosphor Bronze	1922°F
Everdur	1866°F
Ambrac	2102°F
Deoxidized Copper	1981°F



Motor truck brake shoes, worn beyond usefulness, were restored to service by means of Tobin Bronze Welding.

TOBIN BRONZE* WELDING

For Building Up Worn Surfaces—Economically

The motor truck brake-shoes illustrated above were worn beyond usefulness. Instead of discarding them, the owner had the worn areas built up with Tobin Bronze, applied by the oxy-acetylene process. The repair was quickly made at a fraction of the cost of new brake-shoes. When restored to service, the brakes functioned perfectly.

This is typical of the manner in which expensive replacements can be avoided by building up worn machine parts with Tobin Bronze. Due to the low welding temperature required—Tobin Bronze flows freely at 1650° F.—pre-heating is usually unnecessary. This saves time and also minimizes danger of shrinkage or distortion of the parts to be welded. Tobin Bronze is easy to machine and finish.

Because of these properties and because of its high strength, ductility and uniform composition, Tobin Bronze is recommended as the best material for general oxy-acetylene welding of cast-iron. Many industrial plants, having proved the economy of Tobin Bronze Welding for repairs, are now using it to save time and money in manufacturing operations.

Tobin Bronze is exclusively an Anaconda product. Every Tobin Bronze Welding Rod bears the name TOBIN BRONZE stamped in the metal. They may be obtained from distributors of welding equipment and supplies.

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The Central Steel and Wire Company with main offices at Chicago, Illinois and branch offices at Detroit and Dayton, have been made distributers for the products of the Koro Corporation, Waukegan, Illinois, manufacturers of welding wire.

"Welding in Power Plant Construction and Maintenance" is the title of a paper to be presented by Mr. H. H. Moss of the Linde Air Products Co., New York, N. Y. during the Thursday afternoon session of the Midwest Power Engineering Conference which will be held in Chicago, February 12, 13, 14, and 15, 1929.

Mr. C. N. Browne, M. E., formerly sales engineer with the Greensboro Machinery Co. of Greensboro, N. C., has recently been appointed general sales manager of the Owen Electric Manufacturing Co., of Fayetteville, N. C. This company manufactures the Owen Induction Electric Arc Welders and will early next year add electric spot, butt, and automatic seam welders. Also inductional water heaters and electric refrigerating units will be added to their present line of electrical devices.

The regular monthly meeting of The Victorian Institute of Welding Engineers of Melbourne, Australia, was held at the Way and Works branch of The Victorian Railways, Spotswood, during the afternoon of Wednesday, October 24, 1928. The topic under discussion was "The Application of Welding by Workshop Operators."

The Weldit Acetylene Company of Detroit, Michigan, has recently opened two new sales and service offices, one at 538 South Dearborn St., Chicago, Illinois, and the other at 71 West Huron St., Buffalo, N. Y. These offices will handle complete lines of welding equipment for the acetylene welding industry in their districts.

Mr. John J. Crowe of the Air Reduction Co., Jersey City, New Jersey, is giving lectures at Temple University, Philadelphia, Pa. in connection with a course in The Heat Treatment and Metallography of Steel. This is being given as an evening course under the auspices of the Philadelphia Chapter of the American Society for Steel Treating. This course was inaugurated in 1921, and has been very successfully carried on every year since that time.

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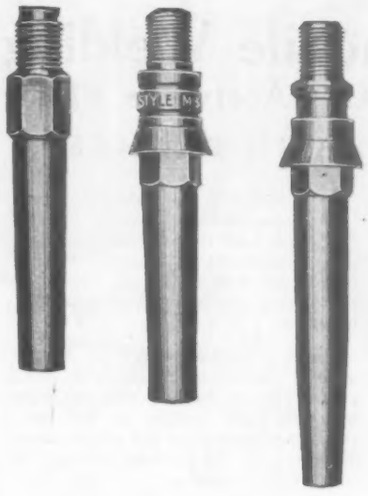

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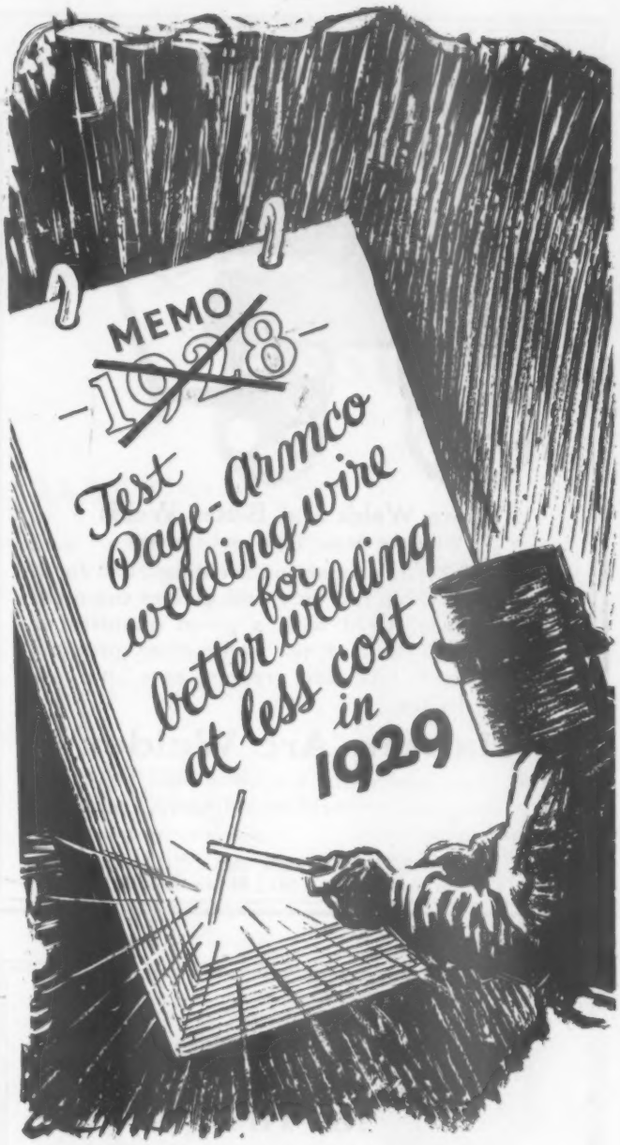

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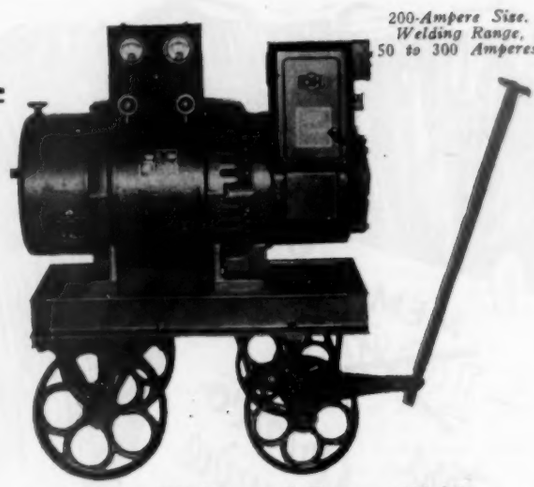

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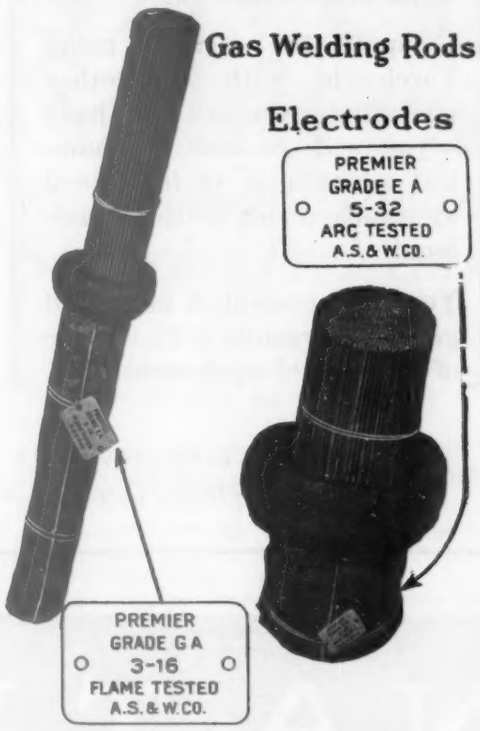

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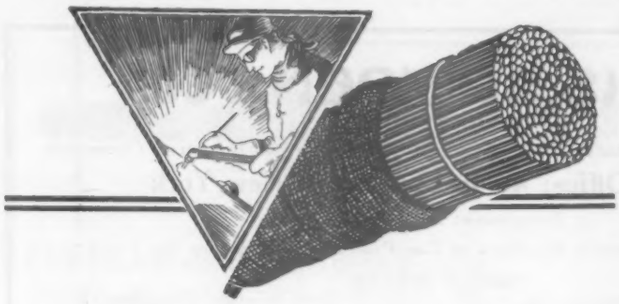

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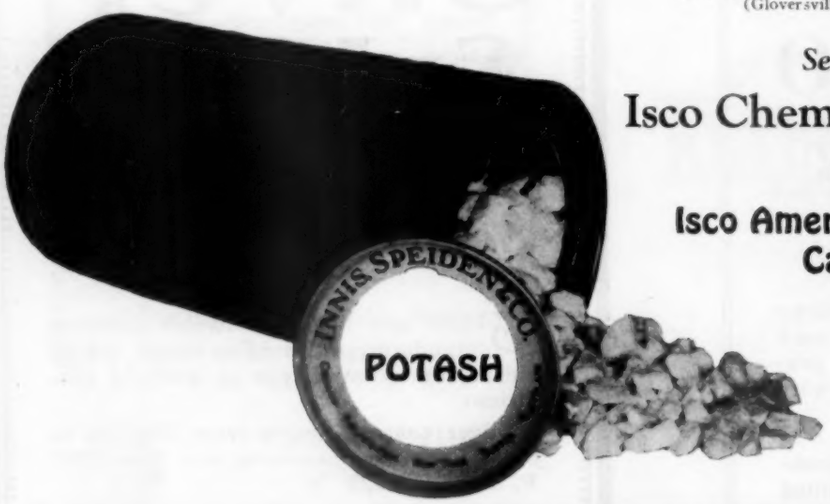

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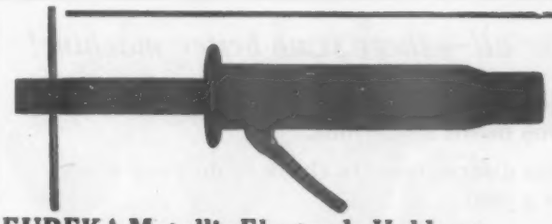

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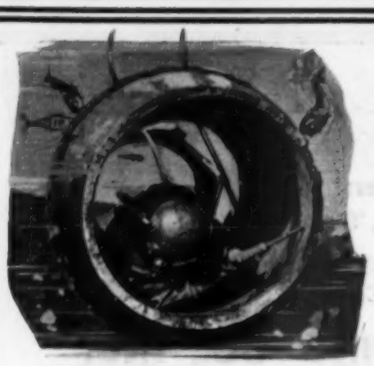

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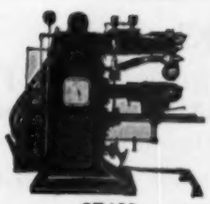

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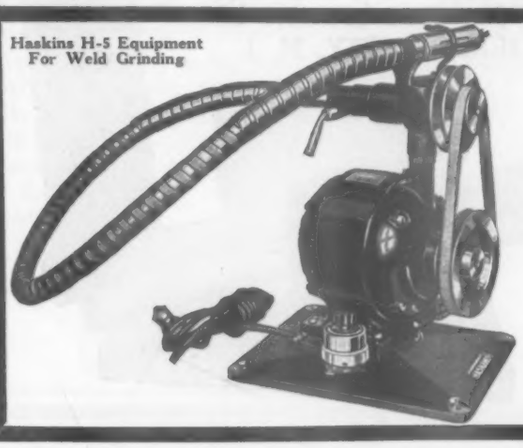

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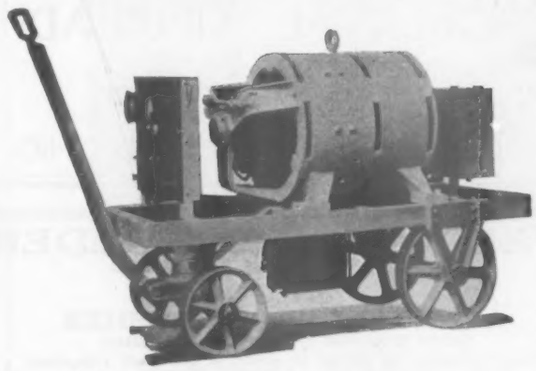

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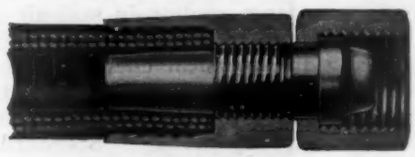

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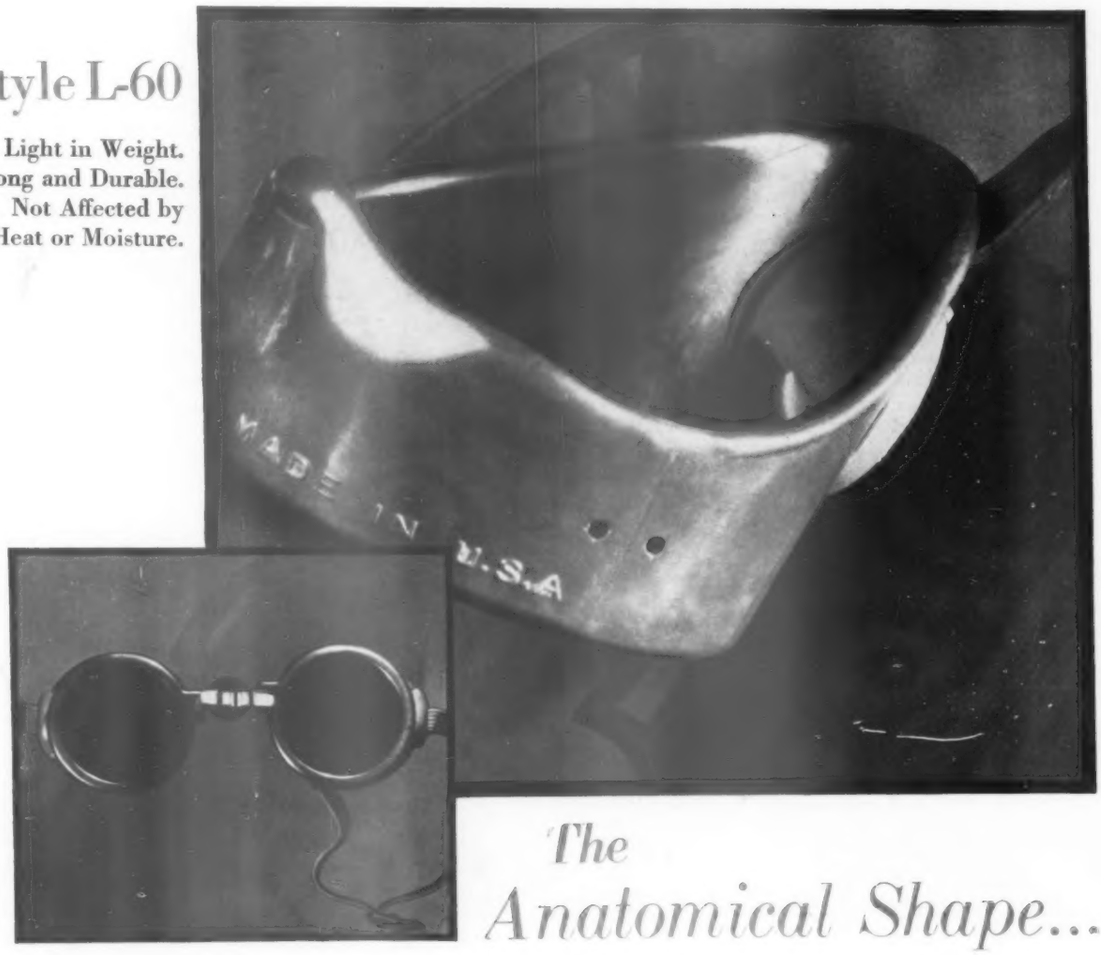

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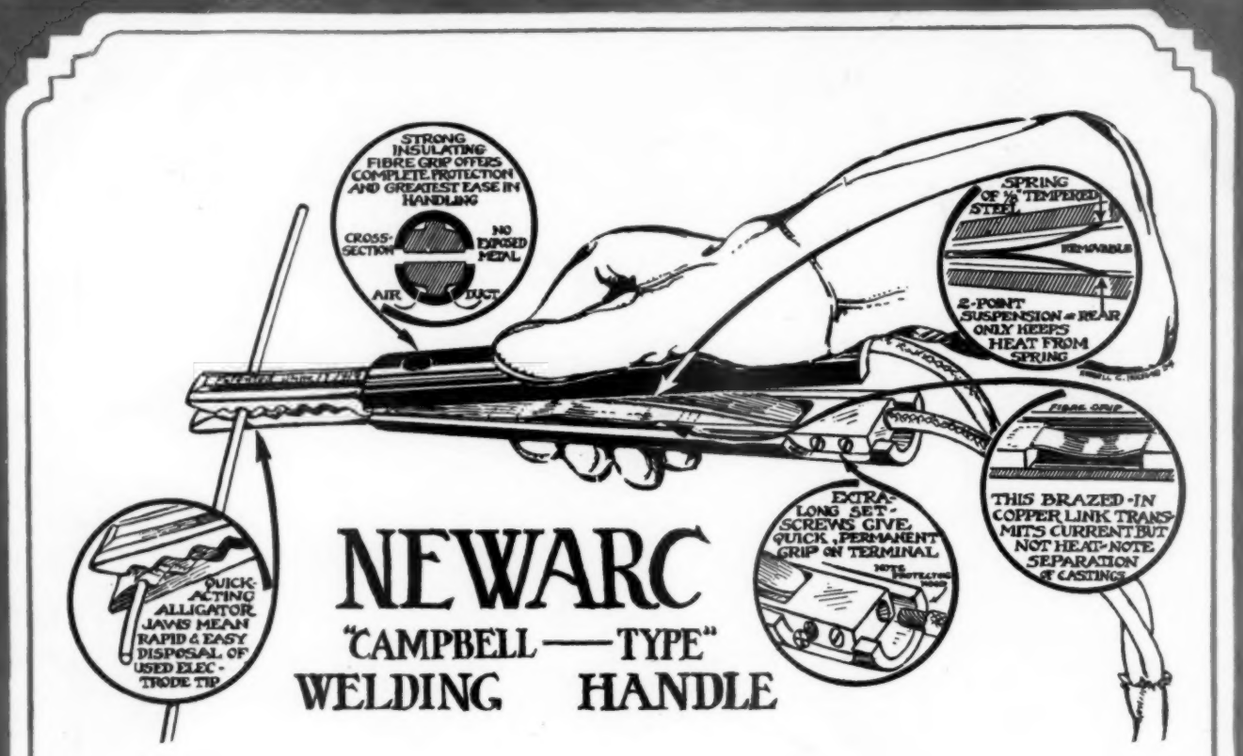
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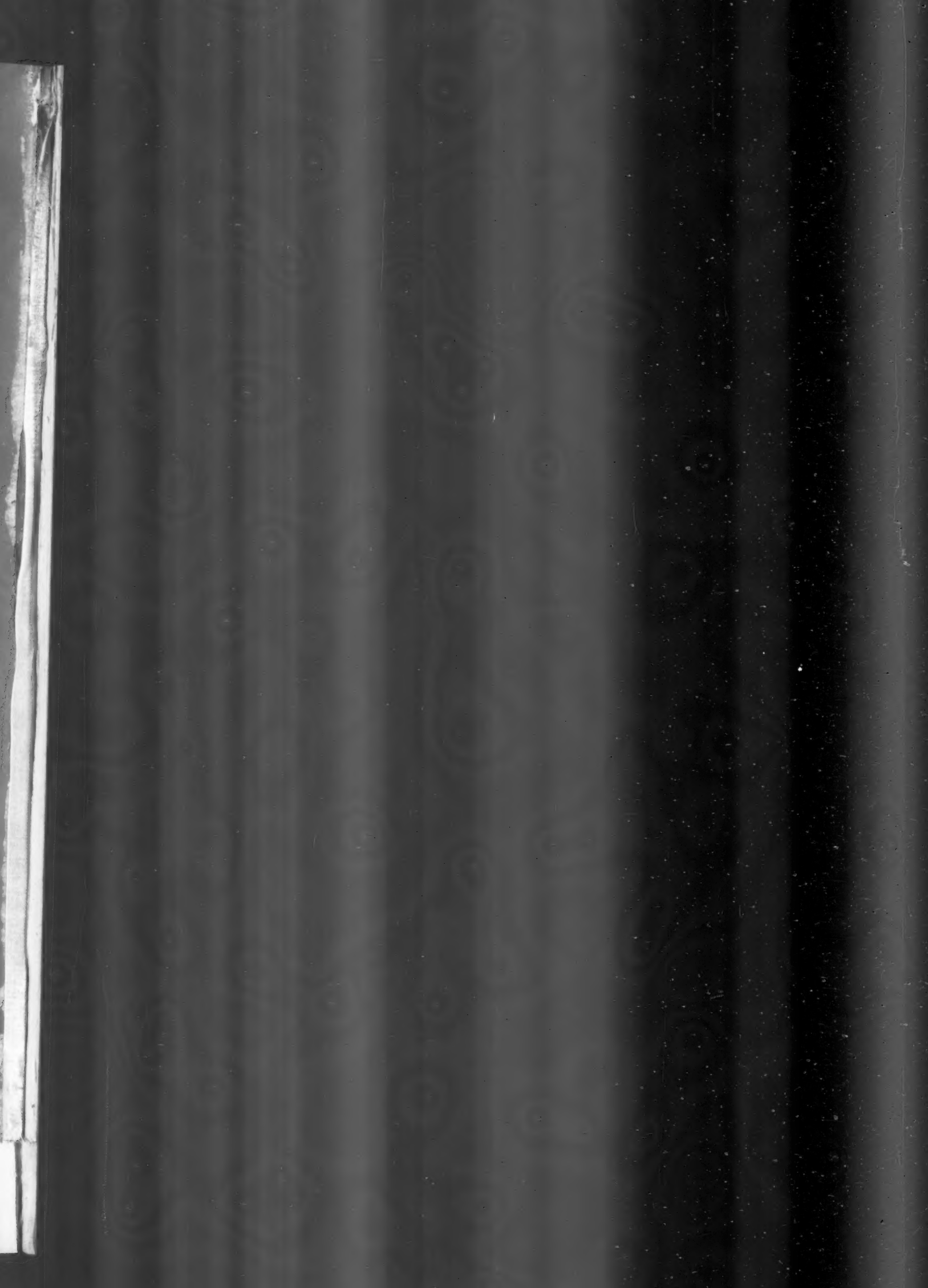
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